BANK OF FINLAND
DISCUSSION PAPERS

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Juha Junttila
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Forecasting the macroeconomy with current financial market information: Europe and the United States

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The paper was written whilst the author was visiting the Bank of Finland. The generous support from the research department is gratefully acknowledged. Thanks are due to Juha Tarkka, Matti Virén, Jouko Vilmunen, David Mayes and the participants at the Bank of Finland economist seminar for very helpful comments on earlier versions of the paper, and to Heli Tikkunen for research assistance, and to Päivi Lindqvist for the editorial help.

Suomen Pankin keskustelualoitteita
Finlands Banks diskussionsunderlag

http://www.bof.fi

ISBN 951-686-765-0
ISSN 0785-3572
(print)

ISBN 951-686-766-9
ISSN 1456-6184
(online)

Suomen Pankin monistuskeskus
Helsinki 2002

Forecasting the macroeconomy with current financial market information: Europe and the United States

Bank of Finland Discussion Papers 2/2002

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Abstract

Using recently developed modelling methodology of Economic Tracking Portfolios (ETP), we find that it is possible to forecast future values of inflation and changes in industrial production in the United States and at least three core euro countries – Italy, France and Germany – utilising only current and past financial market information. The longer the forecasting horizon, the better the forecasts based solely on financial market information compared to results from other methods. Of the analysed countries, the overall forecasting performance of the tracking portfolios is the best for the United States, and the method employed here clearly outperforms the forecasting performance of a more traditional VAR approach.

Key words: financial markets, forecasting, macroeconomy, euro area, USA

JEL classification numbers: C53, E44, G15

Makrotalouden ennustaminen nykyistä rahoitusmarkkinainformaatiota käyttäen Euroopassa ja Yhdysvalloissa

Suomen Pankin keskustelualoitteita 2/2002

Juha Junttila
Tutkimusosasto

Tiivistelmä

Tutkimuksessa käytetään uutta taloudellista tilaa jäljittävien sijoitussalkkujen menetelmää tulevan makrotaloudellisen kehityksen ennustamiseen Yhdysvalloissa ja kolmessa euroalueen ydinmaassa; Italiassa, Ranskassa ja Saksassa. Tutkimustulosten perusteella pelkästään nykyistä ja aikaisempaa rahoitusmarkkinainformaatiota käyttäen on mahdollista ennustaa tulevaa inflaatiota ja teollisuustuotannon muutosta näissä maissa. Kun saatuja ennusteita verrataan perinteisempiin, VAR-perusteiseen makromalliin pohjautuviin ennusteisiin, havaitaan, että pelkkään rahoitusmarkkinainformaatioon perustuva ennustemalli toimii parhaiten Yhdysvalloissa ja että sitä käyttäen laaditut ennusteet ovat selkeästi parempia kuin VAR-mallin mukaiset ennusteet. Mitä pitempi ennustejakso on, sitä paremmin pelkkään rahoitusmarkkinainformaatioon perustuvat ennusteet menestyvät eri menetelmien vertailussa.

Asiasanat: rahoitusmarkkinat, ennustaminen, makrotalous, euroalue, Yhdysvallat

JEL-luokittelu: C53, E44, G15

Contents

1 Introduction

Recently in public discussions the possible role of financial market returns having effects on the development of future macroeconomy has often emerged as a hot topic. For example, chairman of the US Federal Reserve Board of Governors, Mr Alan Greenspan has frequently stimulated the discussion and also academic research on the relationship between the financial market wealth and future values of macroeconomic variables, like private consumption, for instance[1]. Also the academic research community has for long time been interested in the relationships between the financial markets and the macroeconomy.

The mainstream empirical approach in the financial market vs. macroeconomy analysis has been the application of Vector AutoRegressive models in studying the effects of macroeconomic innovations in the pricing equations of financial market assets. This framework is based on the pioneering work of Campbell (1991) and Campbell and Ammer (1993). All the studies in this category mainly assume a priori that the direction of "indicator power" goes from the macroeconomy to the financial market. However, in this paper we turn this traditional point of view the other way around. Theoretically this can be done using a very recently advocated approach introduced as an Economic Tracking Portfolio (ETP) analysis in Lamont (2001). Previously the ETP framework has been empirically analysed in the closed economy context in Hayes (2001) and Lamont (2001) and in an open economy context in Christoffersen and Slœk (2000).

In ETP applications the results on especially the out-of-sample forecasting performance have been quite poor previously. However, in this paper we emphasize that first of all, the reason for this might be that this kind of analysis should be performed using an international data set (ie national stock and currency returns), and secondly, that the tracking portfolios should consist only of a fairly small number of assets. Finally, we also wish to give more attention to the choice and role of so the called control variables in the ETP analysis.

The need for considering the international framework is obvious when viewing for example the results in Bekaert et al (2002), who specified a reduced-form model for a number of financial time-series from 20 emerging markets and search for a common, endogenous break in the process generating the data. They also employed information on a variety of financial and macroeconomic indicators to interpret the results and to identify the likely date the equity market becomes financially integrated with world capital market. They found that the endogenous break dates can be accurately estimated but they did not always correspond closely to dates of official capital market reforms, and the estimated endogenous break dates seemed to appear usually later than

[1] See his speech on August 31st 2001 at a Fed Bank of Kansas City symposium in Jackson Hole, Wyoming (http://www.federalreserve.gov/boarddocs/speeches/2001/20010831/default.htm). Recent research on especially the stock market effects on consumption has been executed specifically by the Fed researchers like Dynan and Maki (2001) and Ludvigson and Steindel (1999). An extensive recent review on forecasting values of macroeconomic variables with asset prices and returns in general is given in Stock and Watson (2001).

official dates which emphasises the important distinction between market liberalisation and market integration.

Regarding the international financial market dependencies, for example Richards (1995) has previously found that national stock market indices include a common world component and two country-specific components, one permanent and one transitory. More recently, Bhojraj and Swaminathan (2001) have studied momentum and reversal effects in portfolios of international stock indices. Their results indicate strong momentum up to a year following the portfolio formation date and significant reversals in the subsequent two years. While the stock momentum seemed to be driven mostly by predictability within equity markets, reversals seemed to be at least partly due to a continuing decline in stock prices in response to past currency appreciation. These patterns seemed to be related to misreaction to news especially about macroeconomic conditions, not corporate earnings.

The results in our paper are very much in favour of using the ETP approach with an international portfolio data set in out-of-sample macroeconomic forecasting. The main result is that it is possible to forecast future values of inflation and changes in industrial production in the US and at least three core Euro countries, ie Italy, France and Germany utilising only the current and past financial market information. Furthermore, the longer the forecasting horizon the better are these macroeconomic forecasts based purely on financial market information, and among the analysed countries the overall forecasting performance of the tracking portfolios is the best in the US and clearly outperforms the forecasting performance of a more traditional VAR approach.

The structure of the paper is the following. In section 2 we give an overview of the most recent literature related to our study. Section 3 contains a detailed description of the theoretical background for our analysis, starting from the rational valuation formula for common stocks, and proceeding to its connection to the theoretical background for the ETP analysis. In section 3 we also describe the estimation procedure for the ETP weights. In section 4 we discuss the data issues in this kind of analysis and the main results in the two most recent papers concerning the ETP framework. Section 5 we gives the description of our data and discusses the results from the preliminary analysis. Section 6 contains the overall results from the empirical analysis and in section 7 we give conclusions and suggestions for further research.

2 Review of the most recent relevant literature

According to modern financial theory (see for example Cochrane (2001)), the value of a financial asset is equal to the sum of its discounted expected future cash flows. Thus, any macroeconomic variable that systematically influences either the discount rate or the expected cash flows will have an effect on observed returns. Previously the main theoretical approaches to investigate the association between, for example, the stock returns and the macroeconomy in the form of an asset pricing model have been offered by the intertemporal version of Sharpe's (1964) Capital Asset Pricing Model (ICAPM, see Merton

(1973), and more recently Merton (1994), and also Breeden (1979)), or the Arbitrage Pricing Theory (APT), originally formulated by Ross (1976). According to for instance the intertemporal version of the CAPM, macroeconomic variables may represent state variables that have an effect on the investors' preferences over time and consequently, influence the expected rate of return. In academic research, and also in the supporting market analysts' research for finance practitioners, the main theoretical and empirical frameworks have concentrated in examining this relationship based on a presumption that the direction of indicator power (very loosely speaking causality[2]) between these two economic sectors goes from the macroeconomy to the financial markets and not vice versa. These studies have mainly utilised different versions of the intertemporal asset pricing models with more than one factors supposed to have been priced as macroeconomic risks in the financial markets. Among recent empirical studies in this framework are for example the papers by Vassalou (2000a), Liew and Vassalou (2000) and Fama and French (1998, 1996). All these papers concentrate on the stock market forecasting power for future real growth in the economy.

On the other hand, for example Rigobon and Sack (2001) and Lange, Sack and Whitesell (2001) analysed the forecasting power of the financial market on expectations of monetary policy changes. For instance, Rigobon and Sack (2001) argued that movements in the stock market can have a significant impact on the macroeconomy and are therefore likely to be an important factor in the determination of monetary policy, too. They used an identification technique based on the heteroskedasticity of stock market returns to identify the reaction of central bank's monetary policy to the stock market. According to their results the Federal Reserve systematically responds to stock price movements only to the extent warranted by their impact on the macroeconomy.

The most commonly used empirical approach in the financial market vs. macroeconomy analysis has been the application of Vector AutoRegressive models in studying the effects of macroeconomic innovations in the pricing equations of financial market assets, along the lines of the pioneering work by Campbell (1991) and Campbell and Ammer (1993). More recently, Cuthbertson et al (1999a) examined the movements in UK aggregate stock prices using annual data and decomposing the variance of unexpected real stock returns into components due to revisions in expectations of future dividends, discount rates and the covariance between the two. One of their main results was that

[2]Instead of speaking about "causality", a more appropriate term would here be something like the "direction of forecasting ability", meaning that especially in the literature on financial market/macroeconomy relationships it would be absurd to assume that for example changes in the stock market returns could actually "cause" changes in the future values of real activity or inflation. Hence, the key point to understand in this area is that in the analysis we have to make the fundamental, but both intuitively and theoretically well argumentable (see section 3) assumption that the possibilities of macroeconomic risks are priced in the financial market and this has an effect on observed and expected (past and current) prices and returns. This indicates that changes in the current and past values of financial market variables might indicate (but not cause) also the development of future values of macroeconomic variables. Notice that for this part the discussion and recent research on constructing "financial conditions indexes (FCI)" is also very much related to our study (see for example Goodhart (2001), Goldman (2001), Mayes and Virén (2001) and McGuckin et al (2001) on FCIs).

the contribution of news about future discount rates is about four times that of news about future dividends, and they found no significant covariance between them. Furthermore, their analysis of excess returns uncovered a positive covariance between news about dividends and news about real interest rates, but since these two elements have opposite effects on current stock prices, their combined effect is negligible. Persistence in expected returns, as well as predictability were found to be important in explaining stock price movements. The essence of their paper was in stock return predictability, and it included also a discussion on the determinants of the expected return (dividend price ratio, yield spread, a default spread, gilt-equity yield ratio). In another recent paper Valckx (2001) used a VAR approach based on the traditional Campbell and Ammer (1993) framework and a monthly data set from the period of 1954:6–2000:12 for the US and Euro-Zone (formed by aggeregating over all the 11 EMU member countries). He incorporated inflation news into the stock and bond return variance decompositions. An explicit attention was given to different horizons over which investors' expectations were supposed to be formed. The general finding was that inflation news volatility was found to be a non-trivial factor in the stock and bond return decompositions for the US and European data.

Vassalou (2000a) analysed the question of how well the news related to future GDP growth can explain the cross-section of equity returns when compared to the traditional Fama and French (1992) factors. Using US data from the period of 1957–1998 she found that the Fama and French value (HML) and size (SMB) factors appear to contain mainly news related to future GDP growth, but a model including the information in HML and SMB which is unrelated to this news could not explain the cross-section of equity returns substantially better than the domestic capital asset pricing model. From an international point of view, the results in Nasseh and Strauss (2000) supported the existence of a significant long-run relationship between stock prices and domestic and international economic activity in six European countries (France, Italy, the Netherlands, Switzerland, the UK and Germany). There the findings from a Johansen (1988) cointegration test procedure demonstrated that stock price levels are significantly related to industrial production, business surveys of manufacturing orders, and short- and long-term interest rates as well as foreign stock prices, short-term interest rates and production. Variance decompositions supported the strong explanatory power of macroeconomic variables in contributing to the forecast variance af stock prices. The overall conclusion for these countries seemed to be that the stock prices are determined by macroeconomic activity.

As another paper with an international point of view, Karolyi and Stulz (2001) first reviewed the international finance literature to assess the extent to which international factors affect financial asset demands and prices. International asset pricing models with mean variance investors predict that an asset's risk premium depends on its covariance with the world market portfolio and, possibly, with exchange rate changes. Furthermore, existing empirical evidence suggests that a country's risk premium depends on its covariance with the world market portfolio and that there is some evidence that exchange rate risk affects expected returns. However, the theoretical asset pricing literature relying on mean-variance investors fails in explaning the portfolio holdings of investors, equity flows, and the time-varying properties of correlations across countries. The empirical analysis in Karolyi and Stulz (2001) revealed that the home bias has the effect of increasing local influences on asset prices, while equity flows and cross-country correlations increase global influences on asset prices. An international investor's point of view was provided also by Vassalou (2000b), who tested for the pricing of exchange rate and foreign inflation risks in equities. Her tests were motivated by the empirical implications of the models of Solnik (1974), as revised in Sercu (1980), Grauer et al (1976) and Adler and Dumas (1983). She found that for a set of monthly returns (from the time of 1973–1990)) data from ten advanced economies, both the exchange rate and foreign inflation risk factors were able to explain part of the within-country cross-sectional variation in returns. This has important implications for hedging exchange rate risk. Furthermore, Vassalou also stressed that the observed home bias, at least in the US equity portfolios, cannot be the result of the US investors efforts to hedge against domestic inflation.

The research papers on the flip side of the coin regarding the macroeconony vs. financial market analysis assume that the direction of indicator power goes from the financial market to macroeconomy fairly directly. For example, using monthly data for the period of 1955–1998 from the US, the UK and Germany, Andreou et al (2000) examined whether financial variables (interest rates, stock market price indices, dividend yields, and monetary aggregates) predict economic activity over the business cycle, and the nature of any non-linearities in these variables. The most reliable leading indicator across the three countries would seem to have been the interest rate term structure, although other variables also appear to have been useful for specific countries. In addition, they reported that the volatilites of financial variables may also contain predictive information for production growth as well as production volatility.

Basically also in this "flip-side" framework the VAR approach is equally natural. An early paper on this subject is Lee (1992), using the VAR specification for investigating the "causal" relations and dynamic interactions among asset returns, real activity and inflation in the postwar US data. His major findings were that the stock returns appear Granger-causally prior and help explain real activity. When interest rates were included to the VAR representation of the data, stock returns explain little variation in inflation, although interest rates explain a substantial fraction of the variation in inflation. Finally, inflation seemed to explain little variation in real activity.

A recent paper on our theme is provided by Stock and Watson (2001), who analysed the predictive power of asset prices for inflation and real output very thoroughly. First they gave a large literature review on the subject and then provided an empirical analysis of quarterly data on up to 38 candidate indicators (mainly asset prices) for seven OECD countries for a span of up to 41 years (1959–1999). Their conclusion was that "some asset prices predict either inflation or output growth in some countries in some periods, but which predicts what, when and where is itself difficult to predict: good forecasting performance by an indicator in one period seems to be unrelated to whether it is useful predictor in a later period". Nevertheless, they suggested that forecasts produced by combining these unstable individual forecasts seem to improve clearly when compared to forecastst obtained from benchmark univariate models.

Finally, as a paper connected to the analytical framework in our study, Christoffersen and Sloek (2000) used a panel of monthly data for the Czech Republic, Hungary, Poland, Russia, Slovakia and Slovenia for the period of 1994–1999 and showed that historical values for interest rates, exchange rates and stock prices signal future movements in real economic activity. They emphasised that this has significant implications for policymakers, and a composite leading indicator for the future development of economic activity, based on the three asset prices, was presented in the paper. Their conclusion was that asset prices do contain information about future movements in real variables, and in particular it was found that asset prices significantly signal future movements in industrial production.

3 Theoretical background

3.1 The rational valuation formula

In the simplest possible framework the relationship between the price formation in the asset market and the development of macroeconomy starts from the examination of a basic pricing equation for common stocks[3], that is

$$p_t = E_t(p_{t+1} + d_{t+1})/(1 + r), \tag{1}$$

where r is the agents' discount rate for future utility (assumed constant in the static version), p_t is the current price of equity share, and d_{t+1} is the dividend accruing to the ownership of the equity share during the holding period. Hence, in equilibrium the current stock price should be a discounted value of the expected future dividend and future price conditional on the available information at time t. An asset pricing formula can be derived from equation (1) by recursive substitution yielding for the first round

$$p_t = E_t\left[d_{t+1} + E_{t+1}(d_{t+2} + p_{t+2})/(1 + r)\right]/(1 + r). \tag{2}$$

Updating equation (1) again i times, substituting for each p_{t+i} from this recursive operation into equation (2), and using the law of iterated expectations $E_t(E_{t+1}(d_{t+2})) = E_t(d_{t+2})$ with an infinite number of substitutions gives the current price on the asset as the expected value of all future dividends, ie

$$p_t^f = \sum_{i=1}^{\infty} \left[1/(1 + r)\right]^i E_t(d_{t+i}). \tag{3}$$

In equation (3) superscript f now refers to the *market fundamentals* price, because we have assumed in the derivation of this model that the discounted value of the expected price infinitely far in the future is zero. Equation (3) is often referred to as the so called rational valuation formula (RVF) for the stock

[3] Equation (1) is only a simplification of the famous Gordon (1962) formula.

price[4]. In deriving this formula we have imposed the terminal or transversality condition

$$\lim_{i \to \infty} \frac{E(p_i)}{(1+r)^i} = 0. \tag{4}$$

Hence, we impose a restriction to the analysis that the pricing equation (3) has finite number of possible solutions[5].

Due to the obvious role of the expectations on future dividends and the discount factor in the rational valuation formula a natural question that arises from this equation concerns the role of economic factos, ie state variables that might have effects on either or both of these two main components of the return generating process of common stocks in general. In addition to the most recent papers listed in section 2, several earlier studies, like for example Barro (1990), Fama (1990) and Lee (1992), have documented the ability of future values of macroeconomic variables to explain substantial fractions of monthly, quarterly and annual aggregate stock return variations for the US market. Peiro (1996) obtained support for these results in several other industrial countries using simply the *changes in stock prices* instead of actual returns. Furthermore, reverse causal relationship between the macroeconomic variables and stock returns (ie from stock returns to macro factors) has also frequently been revealed, like recently in Domian and Louton (1997), who find that there is an asymmetry in predictability of industrial production growth rates by stock returns in that negative stock returns are followed by sharp decreases in industrial production growth rates whereas only small increases in industrial production follow positive stock returns. For the US stock market also Estrella and Mishkin (1998) obtained results in favour of this conclusion. They concluded that stock prices seem to have been especially powerful in predicting recessions particularly one to three quarters ahead.

As suggested by Fama (1990) and Lee (1992) in their influential papers, expected variations in real activities are indeed not the only source of variations in stock returns in standard valuation models. The possible sources can be categorised in three groups (see also Binswanger (1999)), which are

i) shocks to expected cash flows for which for example industrial production can serve as a proxy,

ii) shocks to discount rates, and

iii) predictable return variation stemming from the time varying discount rate used for the pricing of expected cash flows in the basic pricing equation given above. Hence, skipping here the possible presence of speculative bubbles

[4]For more general descriptions of the RVF see for instance Hamilton (1986), Flood & Hodrick (1990) and Cuthbertson (1996), among others.

[5]In case of infinite number of solutions, condition (4) does not hold and one of the possible solutions for the pricing equation would be something where the market price of a share equals the sum of the price determined by fundamentals part and something else that could be called a bubble part. However, in this paper the possible presence of bubbles in the pricing process of common stocks does not have adverse effects on the main methodological tool, ie the ETP methodology (see section 3.2) and hence, the role of speculative bubbles in the stock pricing process is left aside for the moment.

in the market, at time t the realised stock return (R_t) could be decomposed into three parts, ie

$$R_t = R_F + R_P + e_t,$$

where R_F denotes the risk-free rate, R_P measures the risk premium and e_t denotes the unanticipated shocks to stock returns.

Especially source iii) in variations of stock returns is supposed to be connected to changes in R_F and R_P, which are assumed to be responding to *current* business conditions. It was noted already in Fama (1990) and Chen (1991), for instance, that in addition to the effect of *dividend yields* the forecast values of predictable return variations can be affected by various *interest spreads,* too. Their forecasting ability is partly based on their observed correlation with business conditions (like the recent growth rates of production and GDP) over certain periods of time, and hence, they should be able to mimic variations in *expected returns* in response to changes in business conditions. Notice that like mentioned already in the introduction, up until recently the main focus in the analysis for the relationships between the macroeconomy and the financial markets has been in the forecasting ability from the macroeconomy to the financial markets, and basically, also the early work by Fama and Chen also focus on this direction. However, similar kind of arguments and analysis for the dependencies between the financial markets and macroeconomy can be obtained by turning the analytical framework into a form where the forecasting power is within a set of financial market variables. This is possible in the tracking portfolio framework, which we shall next describe. Furthermore, in the tracking portfolio analysis a special emphasis is put on the financial markets' ability to forecast *future*, not so much the contemporaneous values of macro variables.

3.2 Economic tracking portfolios

An economic tracking portfolio (ETP) is a portfolio of assets whose returns track an economic variable, such as expected output, inflation, or returns. From an analytical point of view the ETP analysis is very much related to the use of "maximum correlation portfolios" (MCP) introduced in Breeden, Gibbons and Litzenberger (1989), where MCPs were constructed for tracking current consumption when testing the Consumption Capital Asset Pricing Model (CCAPM). On the other hand, from a financial market vs macroeconomy point of view, the main issue in using ETPs is that the constructed portfolios should have unexpected returns with maximum correlation with news about future macroeconomic variables. Hence, an ETP includes asset returns which have an interpretable economic content. Currently the main interest in constructing tracking portfolios is in their ability to forecast future economic variables, because theoretically, like the traditional Gordon's (1962) growth model suggests, asset returns should basically reflect information about future cash flows and discount rates.

Lamont (2001) points out that tracking portfolios can also be used for measuring risk premia, and they can serve as hedging tools. For example, individuals who wish to insure against inflation could take a position in the inflation tracking portfolio. Due to their possible role as useful tools in forecasting economic variables, and since asset returns are available on a daily basis, tracking portfolios can basically also provide daily, real-time information about the market's expectations about future values of macroeconomic variables.

ETP analysis may be applied to various types of asset pricing models. For example, in the world of the traditional CAP model by Sharpe and Lintner, an economic tracking portfolio would have an *expected* return that is linearly dependent on the covariance with the market portfolio, but its *unexpected* return would still reveal news about future economic variables. We may also assume that there is irrational behaviour (like noise trading) affecting market prices, and hence, due to market inefficiencies returns are at least partially predictable. Nevertheless, as long as asset prices reflect *some* information about future economic variables, tracking portfolio returns will still be useful for precautionary and forecasting purposes.

The ETP analysis for tracking macroeconomic *news* effects starts from constructing portfolios with *unexpected* returns that are maximally correlated with *unexpected* components of certain macroeconomic (state) variables like inflation or real economic activity. The target variable in the tracking operation is "news" about y_{t+k}, where y_{t+k} is the future value of the interesting state variable in period $t+k$. News is defined as changes in expectations (ie, innovations) about y_{t+k} with notation $\Delta E_t\left[y_{t+k}\right] \equiv E_t\left[y_{t+k}\right] - E_{t-1}\left[y_{t+k}\right]$ where E_t is the expectations operator. For example, $\Delta E_t\left[y_{t+k}\right]$ might be the news that the market learns in July 2000 about the change in real economic activity between July 2000 and July 2001. The tracking portfolio returns are defined as $r_{t-1,t} = \mathbf{b}\mathbf{R}_{t-1,t}$, where $\mathbf{R}_{t-1,t}$ is a $1 \times N$ column vector of asset returns from the end of period $t-1$ to the end of period t and $\mathbf{b}$ is a $N \times 1$ row vector of portfolio weights. The tracking portfolio is constructed using *unexpected* returns on the so called base assets, where unexpected returns are actual returns minus expected returns, that is, $\widetilde{\mathbf{R}}_{t-1,t} \equiv \mathbf{R}_{t-1,t} - E_{t-1}\left[\mathbf{R}_{t-1,t}\right]$. The portfolio weights are chosen so that $\widetilde{r}_{t-1,t}$ is maximally correlated with $\Delta E_t\left[y_{t+k}\right]$. In Lamont (2001) the set of base assets consisted of bond portfolios and several industry sorted stock portfolios as well as the market portfolio for the stock market.

Hayes (2001) elegantly demonstrates that the construction of economic tracking portfolios may also well be concentrated purely on the tracking abilities of the stock market via the use of dynamic version of Gordon's (1962) growth model. This analysis is closely related to examining the relationships between financial market returns and macroeconomic variables along the lines in Campbell (1991) and Campbell and Ammer (1993)). This approach is also very much connected to the concepts of leading indicators and mimicking portfolios. However, like Hayes notes, a traditional leading indicator forecasts the level of some variable of interest, whereas an economic tracking portfolio is designed to track a shock, ie innovations of future values, which gives ETPs a degree of interpretability that is absent in standard leading indicators. In the dynamic Gordon setting, starting from the familiar Campbell's (1991) expression but using the notations given above, we may write an equation for the unexpected *excess return* on equity as

$$R^e_{t+1} - E_t R^e_{t+1},$$
$$= (E_{t+1} - E_t) \left\{ \sum_{j=0}^{\infty} \rho^j \Delta d_{t+1+j} - \sum_{j=0}^{\infty} \rho^j r_{t+1+j} - \sum_{j=1}^{\infty} \rho^j R^e_{t+1+j} \right\}, \tag{5}$$

where R^e_t is the (real) excess return on equity, Δd_t is the change in real dividend, r_t is the real risk-free interest rate and ρ is a linearisation parameter ($\rho < 1$). According to this model, financial market participants have a positive unexpected excess return if expected dividend growth is revised upwards, or if expected risk-free real interest rates and/or expected future excess equity returns are revised downwards. Like the previously described rational valuation formula indicates the connection with the macroeconomy comes from the fact that revisions to the components of equity valuation in (5) are likely to be related to changes in expectations of macroeconomic variables of interest. In other words, when denoting $\mathbf{Y}_t$ as a vector of macroeconomic state variables, we have

$$R^e_{t+1} - E_t R^e_{t+1} = f\left[(E_{t+1} - E_t) \mathbf{Y}_{t+j}, j = 0, 1, ..., \infty \right],$$

where $f[.]$ denotes some mapping function from revisions in expectations of macroeconomic variables to unexpected changes in equity prices and returns, too. Hence, when an unexpected equity return in the market is observed, this may contain information on how investors have revised their expectations of the future macroeconomic state. Notice that the mapping function $f[.]$ does not impose any kind of structural relationship for the macro variables and the excess returns. Hence, in its most general form it only simply indicates that innovations concerning future macro values are reflected in unexpected changes in equity returns.

Like already mentioned above, rational valuation (ie, efficient market hypothesis) is not necessary for the construction of ETPs. In case of overractions in the market, suppose first that investors revise their expectations of aggregate output upwards. As a consequence of overreaction, the change in their dividend growth expectations is too high. Alternatively, when they revise their expectations of aggregate output downwards, they may be too pessimistic about the implications for dividends and hence, their expectations about future dividends are too low when they overreact to macroeconomic news. However, even though in these situations the market prices of equities will not be consistent with rational valuation, *unexpected* equity returns will still be correlated with changes in expected output, and this will be captured by a tracking portfolio for output.

The above implication can be obtained when we decompose the actual future values of the target variable into expectations and expectational errors (see also Hayes (2001)). That is, for any target variable y_t, its realised value at time $t + k$ can be written as the sum of the previous period's conditional expectation plus a one-period forecast error, ε_{t+k}, ie

$$y_{t+k} = E_{t+k-1} y_{t+k} + \varepsilon_{t+k}.$$

Correspondingly, we can rewrite the conditional expectation at $t+k-1$ as the sum of the conditional expectation at $t+k-2$ plus the change in the expectation between the two periods, yielding

$$y_{t+k} = E_{t+k-2}y_{t+k} + (E_{t+k-1} - E_{t+k-2})y_{t+k} + \varepsilon_{t+k}.$$

Using backward recursion to time $t-1$ gives an expression

$$y_{t+k} = E_{t-1}y_{t+k} + \sum_{j=0}^{k}(E_{t+k-j} - E_{t+k-j-1})y_{t+k}, \tag{6}$$

where we note that $E_{t+k}y_{t+k} = y_{t+k}$. The second term on the right-hand side of (6) is the sum of $k+1$ one-period expectations revisions, and because expectations are only revised in the light of news, we assume that these are (iid) shocks. A tracking portfolio for y_{t+k} is designed to track the first of these expectations revisions, ie $(E_t - E_{t-1})y_{t+k}$, which is obvious if we rewrite equation (6) as

$$y_{t+k} = E_{t-1}y_{t+k} + (E_t - E_{t-1})y_{t+k} + \xi_{t,t+k}, \tag{7}$$

where $\xi_{t,t+k} \equiv \sum_{j=1}^{k} \varepsilon_{t+j}$ and $\varepsilon_{t+j} \equiv (E_{t+j} - E_{t+j-1})y_{t+k}$. Now, the target variable consists of a sum of the conditional expectation at time $t-1$, the revision to this expectation between $t-1$ and t, and the sum of k one-period future expectation revisions. An ETP gives the connection between the change in expectations of y_{t+k} between time $t-1$ and t, ie, the second term in equation (7) and the unexpected returns on a portfolio of assets, that is

$$(E_t - E_{t-1})y_{t+k} = \mathbf{w}_t'\widetilde{\mathbf{R}}_t + \epsilon_t, \tag{8}$$

where $\widetilde{\mathbf{R}}_t$ is a vector of unexpected returns on N base assets, $\mathbf{w}$ is a $N \times 1$ vector of portfolio weights, and ϵ_t is a tracking error. The left-hand side of equation (8) is in general unobservable, but the estimation and testing of the ETP weights can be conducted in terms of the observable actual future value y_{t+k} (see the next subsection).

For professional forecasters, both in the finance practitioners' sector and in economics research institutes, ETPs would be most useful for policy analysis if they perform well in out-of-sample forecast tests. As a possible real-time forecasting device, one would like to be able to monitor ETP-returns on a frequent basis in order to be able to anticipate what the recent performance of a certain set of financial market assets implies for investors' expectations about future values of some (macroeconomic) target variables. As one possibility, the forecaster might be interested in whether investors in certain parts of financial markets have revised their expectations of future industrial production growth upwards or downwards in response to some macroeconomic shock. However, one of the most important requirements for an ETP framework to be of use in long term forecasting is the presumption that the ETP weights estimated using currently available data are stable enough to track a significant portion of expectations revisions to future values of target variables. This problem raises two further issues for the analysis. The first is the question of sample size utilised for forecasting purposes and the second concerns the question of the frequency in portfolio rebalancing. Like emphasised for example in Hayes (2001), especially in the ETP analysis the issue of portfolio rebalancing is related to the explanatory power/overfitting trade-off. On the one hand, if the time-variation in the "true" portfolio weights is very strong, frequent rebalancing would cover it. On the other hand, when the 'true' weights are fairly stable frequent re-estimation may simply maximise the sensitivity of the weights to random variation in the data, and the out-of-sample performance worsens. Regarding these questions, in this paper we adopt a practitioners view both in terms of the size of the data sample and also the portfolio rebalancing issue. This means that at the final stage of our research the estimation window is only 5 years[6] and the portfolio weights will be rebalanced on a monthly basis.

3.3 Estimation of ETP weights

Like mentioned above, an ETP is one kind of maximum correlation portfolio (MCP), returns of which have the maximum correlation with the target variable of any portfolio of the base assets. Let again y_i denote the target variable and $\mathbf{R}_t$ denote a vector of returns on N base assets. What we need is an $N \times 1$ vector estimate of portfolio weights, $\mathbf{w}$, such that $R_t^{MCP} \equiv \mathbf{w}'\mathbf{R}_t$ is the return on MCP. The MCP weights can be estimated from the OLS regression

$$y_t = \mathbf{w}'\mathbf{R}_t + u_t, \tag{9}$$

and according to the best linear unbiased esimator (BLUE) properties of OLS estimators the estimated parameter vector $\widehat{\mathbf{w}}$ maximises the correlation between the fitted values and the left-hand side variable. OLS produces the MCP weights, because the fitted values of equation (8) are exactly the portfolio returns.

However, in the ETP approach we use *unexpected* asset returns to track the revision in expectations between periods t and $t+1$ of the target variable y as far as k periods ahead. In the MCP framework we would use OLS estimation directly on equation (8). The problem is that in equation (8) neither the left-hand side nor the right-hand side variables are actually observable. Lamont (2001) derives an alternative expression for the regression equation that can be used to estimate the ETP weights. When substituting equation (8) into equation (7) we obtain

$$y_{t+k} = E_{t-1}y_{t+k} + \mathbf{w}_t'\widetilde{\mathbf{R}}_t + \epsilon_t + \xi_{t,t+k}. \tag{10}$$

[6] The use of 60 months span of data is very common in applied financial research (see recently Griffin (2001), for example).

Next we make a crucial assumption that the expected return on the ith base asset is a linear function of a vector of L control variables $\mathbf{Z}_t$, ie $E_{t-1}R_{it} = \mathbf{b}'\mathbf{Z}_{t-1}$. Hence, the vector of unexpected returns on the base assets is then

$$\widetilde{\mathbf{R}}_t = \mathbf{R}_t - \mathbf{b}'\mathbf{Z}_{t-1}, \tag{11}$$

where $\mathbf{b}$ is now an $L \times N$ matrix. Using equation (11) for substituting out $\widetilde{\mathbf{R}}_t$ from equation (10) yields

$$y_{t+k} = E_{t-1}y_{t+k} + \mathbf{w}'\mathbf{R}_t - \mathbf{w}'(\mathbf{b}'\mathbf{Z}_{t-1}) + \epsilon_t + \xi_{t,t+k}. \tag{12}$$

Finally, we may write the projection of the conditional expectation of y_{t+k} on the control variables $\mathbf{Z}_{t-1}$ as

$$E_{t-1}y_{t+k} = \mathbf{a}'\mathbf{Z}_{t-1} + v_{t-1,} \tag{13}$$

where $\mathbf{a}$ is $L \times 1$ vector. Substituting equation (13) into (12) yields

$$y_{t+k} = \mathbf{w}'\mathbf{R}_t + \mathbf{c}'\mathbf{Z}_{t-1} + \varepsilon_{t,t+k,} \tag{14}$$

where $\varepsilon_{t,t+k} \equiv v_{t-1} + \epsilon_t + \xi_{t,t+k}$, and $\mathbf{c}' \equiv \mathbf{a}' - \mathbf{w}'\mathbf{b}'$. The ETP weights are based on the parameter vector applied to base asset returns $\mathbf{R}_t$ and obtained originally from the OLS estimation of equation (14). The unexpected ETP returns are obtained by attaching the estimated weights from (14), $\widehat{\mathbf{w}}$, to the vector of unexpected base asset returns from equation (11). The coefficient vector $\mathbf{w}$ in equation (14) is same as those on unexpected returns in equation (8) (see also Hayes (2001)). Now, because the control variables $\mathbf{Z}_{t-1}$ measure expected returns, the coefficients on the actual returns in equation (14) will be the same as if the unexpected returns were included while the control variables were excluded (as in equation (8))[7].

Finally, it is obvious that regression (14) is equivalent to regressing y_{t+k} on $\widetilde{\mathbf{R}}_t$, and it might not be immediately obvious that in estimating the parameter vector $\mathbf{w}$ only the linear relationship between $\widetilde{\mathbf{R}}_t$ and $(E_t - E_{t-1})y_{t+k}$ is being picked up, like equation (8) requires. However, if investors' expectations are efficient in a way that the expectation formed at time $t-1$ uses all known relevant information, $\widetilde{\mathbf{R}}_t$ must be independent of all other components of y_{t+k}. Furthermore, the unexpected return between $t-1$ and t cannot be correlated with $E_{t-1}y_{t+k}$ and neither can it be correlated with shocks to investors' expectations from $t+1$ onwards. Hence, any correlation between y_{t+k} and $\widetilde{\mathbf{R}}_t$ can only arise because $\widetilde{\mathbf{R}}_t$ is tracking $(E_t - E_{t-1})y_{t+k}$.

The primary use of regression (14) is for the statistical inference on the portfolio weights. However, it is worth to notice that the regression error in (14) is the sum of three components: the ETP tracking error, ϵ_t, the $k-$step ahead forecast error for y_{t+k}, $\xi_{t,t+k}$, and the error between the time $t-1$ expectation of y_{t+k} and the projection using only the control variables, v_{t-1}. Although ϵ_t is iid, it is likely that v_{t-1} will be serially correlated. Furthermore,

[7] Because $E_{t-1}y_{t+k}$ is correlated with $\mathbf{Z}_{t-1}$, the control variables are included separately, which reduces the error variance in equation (14) leading to more precise estimates of the ETP weights.

a k-step ahead forecast error such as $\xi_{t,t+k}$ gives rise to a moving average error of order $k-1$, and all these violations to optimal estimator properties should be taken into account in the estimation procedure. For example, in Hayes (2001) the joint significance of the portfolio weights was tested using a Wald test with Newey-West covariance matrix and truncation lag of 24, which should be sufficient to account for the degree of serial correlation in these regressions.[8] The usual way the empirical analysis proceeds is the adoption of zero cost portfolio returns for $\mathbf{R}_{t-1,t}$. Hence, there is no need to impose the restriction that the portfolio weights in $\mathbf{b}$ have to add to anything, and the resulting tracking portfolio is also a zero cost portfolio because it is a linear combination of zero cost portfolios. Excess returns measure the return on a zero-cost portfolio, with the long equity position being exactly offset by a short position in the risk-free asset. Here we use the zero cost portfolio returns calculated as excess returns $\mathbf{R}^e_{t-1,t}$ in excess of a short-term (3 month) money market interest rate.

4 Data and results in the two most previous papers on ETP analysis

In his study concentrating on the US data, Lamont (2001) utilised seven target variables; industrial production growth, real consumption growth, real labour income growth, inflation, excess stock returns, excess bond returns and Treasury bill returns. Hence, his set of target variables included other than purely macroeconomic variables, too, which actually brings his research exercise more connected to the traditional VAR-type analysis in this area, like for instance in Campbell and Ammer (1993). All the purely macroeconomic time series, ie the first four in the above list, were seasonally adjusted except for inflation. The data span covered monthly observations from 1947:1–1995:12 for the target variables, and a year shorter period for the base assets. Hence, the "tracking horizon" k was 12 months. The set of base assets consisted of four bond portfolios, eight industry-sorted stock portfolios, and the market portfolio for the stock market. All returns were in excess of the T-bill return. The set of control variables included nine variables (plus a constant term in the estimation); the Treasury bill returns, a term premium for long-term government bonds, a term premium for one-year government notes, a default premium for corporate bonds, a default premiun for commercial paper, the dividend yield on the CRSP value weighted aggregate portfolio, 12-month production growth, CPI inflation and excess stock returns. Hence, his sets of variables were very large, which might a priori have effects especially on the out-of-sample foreasting performance.

The whole sample results in Lamont (2001) were in favour of the return variables being able to forecast the target variables given the chosen control variables in $\mathbf{Z}_{t-1}$. One of his main conclusions was that it was feasible to track

[8] In fact, the qualitative findings were unaffected when the truncation lag was varied between 12 and 24.

all the seven target variables using the base assets. Furthermore, it seemed that the forecasting power of the asset returns was not limited to just the aggregate stock market. In general, both bonds and stocks seemed to have contributed to the tracking power. The out-of-sample performance of the tracking portfolios was analysed using a rolling 20-year estimation window, and in terms of a mean squared forecast error based (MSE) measure for the goodness of out-of-sample forecasts. The forecasts obtained from the tracking procedure for the production and T-bill returns were fairly useful out-of-sample, and the labour income and inflation forecasts were somewhat useful, whereas the consumption, stock, and bond returns forecasts were not useful. In summary, tracking portfolios seemed to track out-of-sample, but fairly imperfectly. Furthermore, when the analysis was executed without the control variables, it seemed that the tracking portfolios still tracked, but excluding lagged control variables made dramatic differences in the tracking properties for individual target variables.

Hayes (2001) used a monthly UK data set and the largest usable sample period after data transformations covered the observations from February 1965 to February 2000 (421 observations). He constructed ETPs for inflation, industrial production growth, and growth in the volume of retail sales, and all three were measured as annual percentage changes. The forecasting horixon, k, varied from 0 to 24 months, but for brevity, only the results for $k = 0, 6, 12$ and 24 were reported. Two different sets of base assets were used; the first comprised of eight broad industry-based equity portfolios and the second set consisted of 29 industry-based portfolios, which were a disaggregation of the first set[9]. In both cases the aggregate market index (which was not an exact linear combination of the industry portfolios) was added to the set of portfolios, giving 9 and 30 base assets, respectively. The results were given only for the smaller number of base assets. One-month log excess returns were used, and in the absence of a one-month rate, the 3-month Treasury Bill yield was used as a proxy for the "risk-free" interest rate.

Based on previous studies by, for example, Campbell (1987), Fama and French (1988), Pesaran and Timmermann (1994), and Clare, Thomas and Wickens (1994), Hayes (2001) used four control variables, which were the dividend yield on the total equity market, the three month Treasury Bill yield, the change in the three-month Treasury Bill yield, and the yield on a consol. However, due to the lack of proven concensus on which variables are best able to capture time variation in expected equity returns, he also studied the sensitivity of the ETP estimates to the choice of control variables.

The inference from the full-sample results for nine base assets was in Hayes (2001) based on the following two Wald-tests. The first test (Wald 1) tested for the null hypothesis that all the ETP weights were jointly equal to zero and the second test (Wald 2) was for the null where all the other portfolio weights were zero except for that on the market return (which addresses the question of whether allowing the portfolio weights to differ from those of the market portfolio adds anything to the explanatory power of equity returns).

[9] The portfolios were taken from Datastream, and were the capitalisation-weighted Level 3 and Level 4 portfolios.

Results from the Wald 1 test were that the tracking portfolios were significant for all three target variables for all horizons at 10% significance level, but at 5% level the one-year-ahead inflation portfolio and the two-year ahead portfolio for the industrial production growth (IPG) were insignificant. From Wald 2-tests the implication was that with only one exception (IPG with k =12) the eight sectoral indices added significantly to the tracking portfolios' explanatory power. Hence, there seemed to be some benefit to he had (in terms of explanatory power) from allowing portfolio weights to deviate from the capitalisation weights of the market portfolio.

When the control variables were omitted from the ETP regression, for industrial production growth there seemed to be a marked effect on the viability of ETPs, which generally became insignificant. However, this had only little impact on the significance of the ETPs for the other two macro variables. Nevertheless, the tracking portfolios seemed to be very different, depending on whether the control variables were included or not. The overall conclusion was that the choice of control variables potentially has a signficant effect on the estimated portfolios.

The main result from the out-of-sample analysis in Hayes (2001) was that the performance of the ETPs is poor. In fact, many of the point estimates for his out-of-sample forecast measure were negative, indicating that these portfolios on average were in the wrong direction out of sample. Of those portfolios producing a positive value for the performance measure, a number of them were significantly positive. The overall impression from the results was that the ETPs are unlikely to be much use for out-of-sample forecasting. There was also only little qualitative difference between the results from the portfolio rebalanced every month and those rebalanced on a quarterly basis, nor was there any perceivable benefit to lengthening the estimation window for the portfolio weights.

5 Description of the data in this paper

5.1 The three groups of variables

In this paper we adopt an international view to the analysis of ETP framework by using a set of US and the core Euro zone data. The data consist of monthly country observations on asset returns and macro variables approximately from the period of 1982:1–2001:6, and the analysed countries are the three core countries of the Euro zone, ie Germany, Italy and France, and the US[10]. For the stock market data the analysis will be executed using returns based on the general price indices for each of the countries.

In addition to using the stock market returns from several countries, in this paper we make another open economy extension to the previous ETP

[10]The stock market country data start from the beginning of 1970, but due to the poor quality of for example the industrial production data in many of the Euro countries during the1970s we start the whole sample from 1982. The stock market data are from Morgan Stanley and the other data from OECD.

studies by using the returns on currency portfolios as the second main group of asset returns. When viewing the theoretical framework described in section 3, this "choice" basically restricts the currencies to be treated as one group of *speculative assets*[11] in the financial markets. Hence, we assume here that among the factors that might be connected to the time-varying discount rate of investors in the dynamic Gordon setting described in the theoretical part are the proportional changes in currency values, ie the currency portfolio returns. In other words, in this paper the excess currency returns appear on the right-hand side of the main ETP regression equation (14) described in section 3.3.

The main emphasis in the ETP-analysis is in focusing the possibly different portfolio weights of the various financial asset returns when explaining the future values of macro variables with the current excess returns of the analysed assets[12]. Here the interesting empirical questions are first of all, that is there any role for a currency portfolio in the analysis, and furthermore, what is the role of US market for each of the Euro countries, and do the Euro markets have any role in forecasting the US economy. The variable "groups" in our analysis are the following:

THE BASE ASSETS: A stock portfolio consisting of the four country assets (returns based on the log changes in general price indices from Germany, France, Italy and the US, index given in US dollars for each of the Euro countries, too), and a currency portfolio (returns calculated as appropriately defined annualised log changes in the value of the US dollar against the

[11] Alternatively, like shown in Junttila and Tarkka (2001), by using some additional equilibrium relationships for the goods market (ie, the purchasing power parity) and the financial market (ie, the uncovered interest rate parity) in the dynamic Gordon setting we might theoretically equally well argue, that the (real) value of the currency (ie, the real exchange rate) should be treated as a state variable, against the risks of which the financial market participants might want to hedge by using some other assets, like stocks and bonds, for example. This obvious dual role of currencies as speculative assets on one hand, and as macroeconomic state variables on the other hand is apparently very interesting, and one of the purposes of this paper is to obtain some preliminary answers for this question, but concentrating only on the speculative asset role here.

[12] Notice that in many of the previous papers on leading indicator properties of asset prices/returns (like recently in Christoffersen and Sloek (2000)) researchers have used real returns, like the Campbell's (1991) framework also basically indicates. However, here we do not deflate the nominal returns, because in addition to the real activity implications we are explicitly interested in the information content of the asset markets regarding future inflation, too. Hence, even if we were to use another price index (like the producer price index) for the deflating procedure and another, like the consumer price index for calculating inflation, due to their strong correlation we might be introducing some a priori spurious dependencies between the left- and right-hand side variables in the main ETP regression equation. Furthermore, Valckx (2001) has shown that in the Campbell (1991) and Campbell and Ammer (1993) framework, where the main emphasis is in using *excess* asset returns it might be advantageous to start the analysis from the presumption that already from the beginning the decomposition of excess asset return involves the inflation and nominal (excess) return innovation components separately (see also Cuthbertson, Hayes and Nitzsche (1999a and b) for more details).

foreign currency[13], see the description for "appropriate definitions" below), where the set of foreign currencies consists of the three core Euro zone currencies.

THE STATE VARIABLES: Future values of inflation (ie, annualised k-month log changes in the consumer price index) and industrial production (annualised k-month log changes in the index value) for all of the analysed countries.

THE CONTROL VARIABLES: Dividend yields (DY) and the term spreads (SPREAD, 10-year interest rate minus 3-month interest rate), and changes in DY and SPREAD from each of the analysed four countries.

Notice that throughout the whole work we aim to keep the overall number of the analysed variables small. Hence, we use only two base asset groups (ie, currencies and stocks, forming together a portfolio of 7 assets), two control variables (and in addition, in the beginning of our analysis, also changes in them) and also two macro variables.

Among the main points and possible analytical lapses in the ETP-analysis is the choosing of data frequencies, especially for the measurement of asset returns. According to the main regression equation in the ETP-analysis the return variables should be measured as one-period returns, which emphasises the possible role of higher frequency of the financial market data when attempting to forecast future longer run values of the state variables. In this paper, we will use annualised monthly returns calculated as annualised monthly changes in the log of prices of the base assets and also the calculation of dividend yields follows this same principle, ie the dividend yield is the difference between the annualised monthly log changes in the total return index and the corresponding changes in the price index in each country.

5.2 Discussion on the preliminary data analysis

In the Appendix the simple correlation coefficients and some figures for the variables in our analysis are given in Tables A1 and Figures A1. Macro variables are denoted as INF# and PROD#, for 4 different future horizons (# = 3, 6, 12 and 24 months ahead) and like the main regression equation requires, the excess asset returns are the current excess returns over a short-term (here a 3-month) interest rate. For the control variables we report correlations regarding only the lagged values of the dividend yields and term spreads, because the changes in controls seemed not nearly as relevant for the analysis as the levels of lagged values. For the sake of brevity we report only the numbers and figures for Germany and the US and only for the 3- and 12-month horizons in the Appendix, but obviously all the empirical results are available on request, and the results regarding all the forecast horizons will be discussed in the text.

[13] To be precise, like for instance in a paper by Bhojraj and Swaminathan (2001) the currency returns are calculated in US dollars, and hence, as rate of change of spot exchange rates (ie, annualized log changes) expressed in US dollar/foreign currency, where the foreign currencies here are the German mark, Italian lira and French franc. This means that a positive/negative currency return represents a depreciation/appreciation of the US dollar against the foreign currency.

In our preliminary analysis we wish to point out three different main features in these first stage results. They are

i) the role of excess returns in "explaining" the future state variables (the main point in the ETP analysis), and the possible differences regarding stock and currency portfolios (and the role of US vs. Euro markets);

ii) the role of control variables in the regressions; and

iii) the role of individual assets in terms of different explanatory power for the state variables in the portfolio analysis.

First, from viewing only the correlation tables in the Appendix it would seem that neither the *individual* excess currency returns nor the excess stock returns would seem to contain very much explanatory power with respect to future values of inflation for any of the Euro countries or the US at any forecasting horizon. However, from the visual inspection of the relevant return and state variables the *portfolios of assets* (stock portfolios and currency portfolios, see the "bundles" of colour lines in every figure) might contain explanatory power, because the figures reveal clear positive joint correlation between the portfolio excess returns (both the stock portfolio and currency portfolios) and future production change and negative joint correlation between the portfolio excess returns and future inflation. These are the first preliminary insights from viewing the tables and figures together. For this part, the effects from the US market would not seem to be very different than the effects from the three Euro area markets. Furthermore, in the US data the correlations between the macro variables and portfolio excess returns would seem to be even weaker (almost zero) than in the Euro zone data.

Next, we discuss the role of control variables in the regressions. From viewing the correlation coefficients between the (lagged values of) controls and state variables we see that their role in the regression equations would seem to be very important. First of all, in every country the lagged values of dividend yields from German, French and the US markets would seem to be highly positively correlated with the future inflation rates, whereas the correlation between the future changes in industrial production and past dividend yields is mainly negative (except the correlation with the Italian market returns) in all the analysed countries[14]. Furthermore, the effects of the term spreads in all the analysed countries would also seem to be highly important, but their sign goes the other way around than in the case of dividend yield (at least for the part of the domestic market for each country). Hence, for the main part, lagged domestic term spreads would seem to be positively correlated with future production changes and negatively correlated with future inflation, but interestingly, for the Euro zone the correlation of the future real activity with the US term spread is negative, whereas in the US economy, future real activity would seem to be positively correlated with both the US and Euro zone term spreads.

Finally, when considering the appropriateness of the ETP-analysis for this overall data set, it would seem meaningful, especially for the part of using the four different assets in the stock portfolio. This indicates that in the ETP-

[14] The signs of correlation coefficients in case of both the dividend yield vs future inflation and dividend yield vs. future industrial production change strongly support the preliminary theoretical findings in the "Gordon-Fisher model" suggested by Junttila and Tarkka (2001).

analysis the estimated separate portfolio weights for each of the assets in the portfolios may be significantly different from zero, and furthermore, the sizes of weights are not dominated by any single asset in the overall portfolio, like the German or the US stocks.

6 Empirical results

6.1 Whole sample results from the ETP analysis

Results from the whole sample estimation are given in Tables A2a–A2d in the Appendix. First we report the results where the sample of usable observations starts from the beginning of 1982 in every case from the overall model, ie including all the lagged control variables, and then the ETP-results when the control variables are omitted. The statistical tests in Tables A2a–A2d for the tracking ability of the different assets are based on four Wald-tests, namely the Wald1-test, which is a test for the tracking ability of excess currency returns in all the analysed three Euro markets together, the Wald2-test for the tracking ability of stock returns in the Euro markets together, the Wald3-test for the tracking ability of the US stock market return, and finally, the Wald4-test for testing the tracking ability of all the 7 assets together.

When analysing the results regarding future inflation, according to the individual parameter estimates and the Wald1-test statistics the currency returns would seem to be able to track the future inflation in Italy and France but not in Germany. However, the Euro stock returns would seem to be important together in tracking the future inflation in Germany at 12 and 24 month horizons. Also the US stock return seems to track very well the future inflation in almost every Euro country and at almost every horizon. For the US economy, the stock portfolio would seem to be the most prominent one in tracking future inflation (at least at 12 and 24 month horizons), but at 2-year horizon also the core Euro area currency portfolio would seem to be relevant at 10% risk level. Furthermore, even though the individual assets would not always seem to be highly important in tracking future inflation in the analysed Euro countries, the Wald4-test statistics indicate that together they are highly relevant indicators of future inflation, except for the shortest term (3-month) inflation in Germany. The same conclusion stems out for the US data at 6, 12 and 24 month horizons.

For future changes in industrial production (Table A2b) it would seem that they can not be well tracked using currency and stock portfolio assets in Germany and France, but for Italy especially the currency returns and the US stock market returns would seem to be able to track future changes in industrial production at every analysed horizon (at 10% significance level). However, it is interesting to find that for the US data at 12 and 24 month horizons, both the Euro area and the US stock portfolios would seem to be highly relevant in tracking future real acitivity in the US. From Tables A2c and A2d we see that especially the stock portfolio tracks future macro values (both inflation and changes in industrial production) perhaps even more poorly in the Euro zone, when the control variables are omitted, but the currency portfolio would seem to be able to track at least future inflation in Italy and France actually very well. Again, also without the "help" of control variables, it would seem to be possible to track changes in future industrial production in Italy from the behaviour of US stock returns. For the US economy there would seem to be some tracking power for future inflation at 12 month horizon both in the currency and stock market portfolios but for future industrial production only the domestic stock portfolio is relevant.

Notice that these OLS-results further emphasize the previously obtained result from the correlation analysis that the role of control variables[15] seems to be highly relevant, and at least for the German data, their role would seem to be of higher importance than the role of tracking portfolio returns. Namely, for the German macroeconomy there is virtually no explanatory power in the tracking portfolio returns (neither currency nor the stock returns (see Table A2c)) especially for inflation, but the control variables, ie the dividend yields and term spreads at domestic and foreign markets would seem to be highly important in 'explaining' the future values of inflation and changes in industrial production.

In addition to the role of the international portfolio diversification the other main issue in this paper is the out-of-sample forecast performance of the ETPs and the first step for the evaluation of it was the examination of the tracking ability of the ETPs via a recursive procedure. In the recursive analysis we always added one observation to the end of sample and kept the starting point the same in all cases, and used the first 5 years of data as the starting sample for the estimations. Also the four different Wald-tests were conducted recursively during this estimation exercise, and the next step of drawing the inferences from our analysis is based on viewing the time series of the various time-varying Wald-test statistics. In addition to testing the significance of the different 'groups' of portfolio weights, we now performed the Wald-tests for the significance of dividend yields from the Euro markets, and the US market, as well as for the significance of the Euro market term spreads and the US term spread for each country.

6.2 Results from the recursive analysis of the tracking ability

Results from the recursive analysis reveal that in Italy the most important asset return tracking future inflation seems to have been the excess return in the US stock market, which tracks future inflation well from 1996 onwards at short horizons (3 and 6 months) and extremely well at long horizons all the time. However, for example the Euro stock market returns would seem to have lost their tracking power since 1996. From the end of 1992 the Euro market currency portfolio excess returns together also seem to have lost their tracking ability at longer than 6 month horizons. For the part of control variables it

[15]Note that at this point we reduced the analysed models by excluding the changes in control variables, because exclusion of them did not affect the tracking ability of ETP returns.

would seem that the Euro market dividend yields have very strong forecasting power throughout the whole analysed sample period and the US market dividend yield approximately from 1996 onwards. At one year horizon both the US and Euro market term spreads loose their forecasting power approximately for a period of 1995– 1998, but seem to have retained it during the last couple of years of the sample. At all other horizons the term spreads are highly significant in forecasting future inflation throughout the whole sample in Italy.

In the German data, the general conclusion is that excess returns track future inflation poorly for all but the two longest horizons, and in 12 and 24 month horizons especially the role of both the Euro and US stock market excess returns would seem to have been highly relevant in tracking future inflation. For the control variables it would seem that the longer the forecasting horizon, the more relevant are all the control variables, but especially the stock market dividend yields (both the Euro and the US market) perform well in forecasting future inflation in Germany also at shorter horizons.

Excess returns on Euro currencies together seem to track poorly future inflation in France. Also the Euro stock returns fail to track future inflation in France, but at least at 12 and 24 month horizons the US stock market return tracks well the future inflation. Moreover, both the Euro market term spread and the dividend yield forecast extremely well future inflation in France at 12 and 24 month horizons. For the US economy it would seem that only at the longest horizons (12 and 24 months) the stock market portfolios (both the US and the Euro portfolio) have been able to track future inflation. On the other hand, in addition to the term spreads, the dividend yields seem to have been able to forecast future inflation fairly well at all horizons until 1995, where the domestic dividend yield looses the explanatory power for the two shortest horizons totally and for the two longer horizons for a period of 1995–1997 approximately.

All the excess returns seem to have contained some tracking power for future changes in industrial production in Italy approximately since 1993, except the Euro stock market return at 6 month horizon. Another interesting finding from Italy is that during the years 1990–1993 all the tracking portfolios seem to have lost their good forecasting ability, which has again been retained from 1994 onwards. It also seems to be the case that even though especially the US stock market excess return is able to track changes in future industrial production in Italy, the forecasting power of US dividend yield is clearly the worst of all the control variables whereas the Euro stock market returns would seem to have been very good predictors of changes in future industrial production throughout the whole sample period and at all horizons (except during the European currency market turmoil in 1996–1998).

In Germany the results at this stage are not at all in favour of good tracking ability of the excess returns on changes in future industrial production. The main part of forecasting power of the ETP-model would there seem to be in the use of control variables. The general conclusion is there that especially the term spreads (both the US and the Euro market) have been extremely good predictors of changes in future real activity during the whole analysed time period and for all the forecasting horizons.

For France the results imply that only the excess return on the Euro stock portfolio is able to track future changes in industrial production and only for the longer, ie 12- and 24-month horizons. Hence, changes in future real activity in France are not at all dependent on currency market excess returns or the US stock market returns. Furthermore, in the set of control variables in addition to the strong role of Euro market dividend yields at longer horizons, the term spreads, especially the Euro market term spreads, have a significant role to play in forecasting future real activity in France.

It would seem that for the US economy only at longer horizons (12 and 24 months) the stock and currency portfolios would seem to be able to track changes in future industrial production. In 12-month horizon only the currency portfolio is not able to track future real activity, whereas for 24-month horizon all the portfolios are able to track changes in future real activity well since 1993. In addition, all except the Euro market dividend yields at 3-month horizon and the Euro market term spreads at 24-month horizon explain changes in the future real activity extremely well.

The overall conclusion from our recursive analysis is that the tracking and forecasting power of first of all, the portfolios, and secondly, the control variables, would seem to be highly dependent on the country and the forecasting horizon. Another clear result from this part of the analysis is that the forecasting performance of the two versions of the ETP-model, ie the model with control variables and the model without them might indeed be strongly affected by instability of the coefficients of the model in question. Hence, the next step in our analysis involves the use of a 5-year moving window in estimating the different versions of the ETP-models and analysing the out-of-sample forecast performance of these versions. The choice of 5-year window was based on the fact that it is commonly known that many financial market practitioners use the previous 60 months data in their forecasting and performance analyses (see also Griffin (2001)). In addition to using the whole model, where the model includes excess asset returns, dividend yields and term spreads from each of the analysed countries for forecasting out-of-sample values for the state variables, we also analysed the cases of models where the control variables were excluded, and finally, simply out of curiosity a version where only the control variables were included[16].

[16] This third 'version' of the ETP-model actually goes to a side-track regarding the previous ETP-studies like Lamont (2001) and Hayes (2001), because they basically considered only the parts where the whole model (excess returns + controls) or a partial model (only excess returns) were analysed. The extension in our work primarily attempts to raise discussion about the role of control variables by themselves. Furthermore, our choices for the controls basically direct the analysis towards the theoretical findings obtained in a recent work by Junttila and Tarkka (2001), where an extension of the dynamic Gordon model has been considered.

6.3 Results on the out-of-sample forecast performance using a 5-year moving window in the estimation

The rolling 5-year estimation procedure utilised the first 60 observations as the starting sample, and hence, the actual rolling exercise was started from March 1987, and the first 3-, 6-, 12-, and 24-month out-of-sample forecasts were formed using the data from 1982:3–1987:3. Thus, for example for forecasting German inflation the last 24-month forecast comparable to the actual future value of the state variable was based on observations from the period of 1994:05–1999:04, because the last observation on actual inflation was from 2001:5. In Table 1 we report the root mean squared errors (RMSEs) from the ETP-analysis. In this paper we use the values of RMSE as the main measure of the out-of-sample forecast performance in all the different variations of our analysis.

It is worth to notice that comparing the forecast performance between the results presented in the three different panels in Table 1 is perhaps not fair for the so called whole model spesification, ie the results in the second panel because there the number of possibly insignificant parameter estimates in the model is the largest. Hence, the most meaningful comparisons should be made within the panels, ie in terms of differences in the forecast accuracy for future inflation and industrial production as a whole on one hand, and in terms of differences in the country results on the other hand. Furthermore, because the number of estimated parameters is the same within every panel in Table 1 for every forecast horizon, also the comparisons between the different horizons within each panel are statistically meaningful.

First, one overall conclusion emerging from these results is that the tracking portfolio approach performs clearly better for forecasting future inflation than for forecasting changes in future industrial production. Every single value for the measure on inflation forecast accuracy in Table 1 is better than the corresponding value on industrial production forecast accuracy. For example, even though among all the analysed countries the ETP approach performs in forecasting future industrial production clearly best in the US data, and for every modification a, b and c, it nevertheless produces generally over two times more accurate forecasts for future inflation also in the US data (compare the RMSE values 5.46, 5.90 and 5.37 in inflation forecasting to the values of 12.57, 13.19 and 12.36, in industrial production forecasting, correspondingly). Another general, and very remarkable feature in the results in Table 1 is that the forecast accuracy seems to clearly improve with increasing forecast horizon, and again, regardless of the extent of the model used for forecasting, ie irrespectively of using only excess returns, the whole ETP spesification or only the control variables. Hence, the role of financial market information would seem to increase with the forecast horizon concerning at least these macroeconomic variables. Finally, the sums of RMSE values over all the forecast horizons reported on the fifth row in each panel enable the comparison between the different country results in general. It seems that when forecasting future inflation the financial market information has been of most importance in France and the US, whereas when forecasting changes in future industrial production the role of financial market information in terms of forecast accuracy has been clearly the highest in the US and Italy. In every case the development of the German macroeconomy seems to have been the most difficult to forecast using only the financial market information analysed in this paper.

Table 1: Forecast error statistics (RMSE = root mean squared errors) from the 5-year rolling regression of the ETP-models.

Forecast horizon	Future inflation in ITA	GER	FRA	US	Change in future ind. prod. in ITA	GER	FRA	US
	a) Using only excess returns							
3	2.03	2.42	1.57	1.99	4.39	7.69	5.25	4.12
6	1.62	2.01	1.15	1.34	3.88	5.41	3.86	3.28
12	1.29	1.83	0.91	1.22	3.55	4.51	3.49	3.04
24	1.10	1.68	0.66	0.90	2.75	3.50	2.71	2.30
$\sum RMSE$	6.05	7.94	4.30	5.46	14.59	21.12	15.32	12.57
	b) Using the whole model							
3	2.06	2.35	1.88	1.77	4.29	8.86	4.97	3.94
6	1.91	2.32	1.40	1.67	4.14	7.90	4.12	3.49
12	1.46	1.24	1.06	1.41	3.78	7.20	4.77	3.05
24	1.10	1.79	0.86	1.03	3.01	5.23	4.13	2.69
$\sum RMSE$	6.53	7.70	5.20	5.90	15.24	29.21	18.00	13.19
	c) Using only the control variables							
3	1.76	2.14	1.66	1.65	3.96	7.57	4.91	3.47
6	1.83	2.10	1.27	1.49	3.76	7.50	3.60	3.42
12	1.36	1.11	0.98	1.25	3.34	6.61	4.47	2.96
24	0.94	1.58	0.73	0.96	2.68	4.38	3.59	2.49
$\sum RMSE$	5.90	6.95	4.66	5.37	13.75	26.07	16.57	12.36

When compared to previous studies on ETP approach, perhaps one of the most important key findings in this paper at this stage is that, at least when using international portfolio return data, it might not be necessary to include any purely macroeconomic variables (like past inflation or past production growth) to the set of control variables in the general version of the ETP model. Naturally, variables like the term spread, and furthermore, also excess currency portfolio returns in the set of our base asset returns, capture some features of the past performance of the macroeconomies, too. Nevertheless, the variables in the right hand side settings of the ETP regression equation in this paper are perhaps more clearly connected to the actual financial market information when compared to the previous studies like Hayes (2001) and Lamont (2001). However, like might be obvious already from the discussion in section 2, a Vector Autoregressive, ie VAR-type framework along the lines in Campbell and Ammer (1993) could be something that might provide a basis for comparison against our ETP results. Hence, the next step in our analysis was to build a benchmark VAR model in order to be able to compare our results to corresponding results from a more traditional modelling framework. The building procedure of the VAR model and its role as an alternative to the ETP approach are described next.

6.4 Building a benchmark VAR model for comparison

The starting point for the construction of a "horse race" model for the ETP-model was the different role of these two modelling approaches (ETP and VAR) in terms of their information content for forecasting purposes. First of all, the main contribution in this paper is in attempting to build a forecasting model which utilises optimally the contemporaneously available financial market information when forecasting future macroeconomic variables. This is the part that the ETP-analysis is supposed to capture. Now, in terms of forecasting performance and informational content of the variables in these two different approaches, the competition between alternative approaches could basically be performed in three different ways. First, we could start from a very large model as a VAR spesification involving values of macroeconomic variables, and also controls and excess returns (ie, the financial market (FM) variables like in the ETP approach), and via paramater restrictions try to find the additional informative value of these FM variables. This would involve a testing procedure designed to reveal the potential advantages of adding the FM variables to a traditional VAR approach, along the lines in Campbell and Ammer (1993), for instance. On the other hand, the horse race could be run between only the "ETP-part" of the large overall VAR model and the overall VAR model, in which case we would obtain an answer to the question of additional informative value of the lagged values of macro variables when they are added to a model where we have the ETP financial market variables already. This is the flip side of the coin for the testing approach discussed as the first alternative.

However, in this paper we wish to emphasise the role of only the contemporaneous financial market information when forecasting future macroeconomy and hence, adopt a different approach as the basis for comparison, which might be labelled to mimic a more traditional macroeconomic forecasting model. In other words, as an alternative forecasting model for the ETP we use a VAR model including only a set of the main interesting macro variables in this paper for a start. Since the international dependencies of the macroeconomies of the analysed countries should equally well be taken into account in this competing approach, we naturally had to introduce also the values of foreign macro variables into the model. Hence, at the beginning the basic competing VAR spesification for each of the different forecasting horizons was written as

$$\mathbf{y}_t = \boldsymbol{\alpha} + \sum_{s=1}^{L} \mathbf{A}_s \mathbf{y}_{t-s} + \mathbf{u}_t,$$

where $\mathbf{y}$ is a vector of 10 variables, comprised of

a) the inflation and industrial production variables (annualised $k-$period values for each different VAR-model for k-period forecasting) from Italy, Germany, France and the US; and

b) the short-term (3-month) composite interest rate from the Euro3 area (ie Italy, Germany and France, see explanation for the use of composite interest rate below) and the US. Vector $\boldsymbol{\alpha}$ is the constant vector and L denotes the lag length in the model.

Here the short-term interest rates have basically a role as variables describing the stance of current monetary policy. An empirical point worth to mention here is that, like is well known, in a VAR model all the analysed variables should be stationary, ie their data generating processes should not contain unit roots. If there are unit roots in the analysed time series a more appropriate modelling procedure instead of using a VAR model in levels (or perhaps, in differences for the part of time series containing unit roots) would be to use a cointegration modelling procedure, like the Johansen procedure. Hence, at this point of our analysis we had to pay some attention to the possibility of nonstationarity of the analysed time series. For this purpose we performed a set of unit root tests for each of the variables. In order to obtain at least fairly robust conclusions from the unit root test results we applied three different test procedures[17].

The main conclusions from the unit root analysis in this paper were the following. All the inflation rate series (irrespective of the measurement horizon) in the three core Euro countries seemed to have behaved like nonstationary (I(1)) time series with zero drift, but for Italy and France, the null hypothesis of unit root was rejected in the DF-test, when a break point in the time series was allowed. For Italy the break point was detected to 1987:7 and for France to 1985:5 at the 3-month horizon, for example. However, at all horizons the US inflation rate seems to have behaved like a stationary time series process. Furthermore, changes in industrial production in all of the 3 Euro countries as well as in the US seem clearly to have been stationary, and both the test procedures with the null of nonstationarity and the null of stationarity were clearly in favour of these conclusions. Finally, according to the unit root test results the short-term interest rates, both the Euro area rate[18] and the US 3-month interest rate seem to have behaved like nonstationary time series with zero drift.

Even though the presence of unit roots in each of the Euro country inflation rate series might indicate that it would be more appropriate to use also a composite inflation rate in the analysis (because they might together form a stationary long-run linear cointegrating relationship), for this part we shall

[17] The first two tests were the standard augmented Dickey & Fuller (1979) test (DF) and the Kwiatkowski, Phillips, Schmidt & Shin (1992) test (KPSS). The DF-test has the null hypothesis of non-stationarity, whereas the KPSS-test has the null of either stationarity around a level or trend stationarity. In addition, we also used an extended DF-procedure by using also tests for the possibilities that the analysed time series are stationary or non-stationary around a zero or non-zero mean, or alternatively, around a zero or non-zero drift. Finally, due to well known poor small sample performance (see for example Li & Maddala (1997)) of the unit root tests and especially, due to their fragility in the presence of structural breaks, for the sake of robustness of our conclusions, we also applied a test procedure introduced lately by Perron (1997). The Perron (1997) procedure (later denoted P97) is designed to detect a possible break point in a single time series. The breakpoint is endogenously chosen so that the standard t-statistics for testing the null hypothesis of a unit root is smallest among all possible break points. Results from all the unit root tests are available on request.

[18] Note that when applying the Johansen (1988) procedure for the set of Italian, German and French 3-month interest rates we found one cointegration vector (the results are available on request), so these three short-term interest rates would seem to have been highly dependent from each other and because the presence of cointegration between them reveals that they form a stationary relationship, we used their composite value, calculated as the GDP-weighted average of these three interest rates as the Euro3 area interest rate in the analysis. This helped to reduce the size of the VAR-model somewhat, too.

remain in using the countrywise variables. The reason for this is that we wish to obtain a VAR-model which we are able to use for forecasting the future values of each interesting macro variable in each of the analysed Euro countries, like was the case in the ETP-model, too. Furthermore, since the unit root test results were not clear-cut at all, we used the inflation rate series in levels for each country, and the discussion on the possibility of nonstationarity will be performed in terms of viewing the sum of the own lag coefficients for inflation in the VAR representation, which should be statistically different from one (below one) for a stationary time series.

Tables A3a–A3b in the Appendix give the main results on the whole sample VAR systems at all the four horizons for the part of the interesting individual equations in the systems, namely the equations for inflation rates and changes in industrial production in Italy, Germany, France and the US. From the tables we see that all the equations extracted from a full VAR model are clearly over parameterised, if they were to be used for forecasting purposes in this form. Hence, next we used the obtained F-test results reported in Tables A3a and A3b for reducing the number of variables in the estimated equations. It is obvious from reading the values in the upper "diagonal" of Table A3a (for tests F1–F4), and correspondingly, from reading the values in the lower "diagonal" of Table A3b (tests F5–F8), that the most important effects in each equation and each horizon come from the own lagged values of the variable in question. However, for instance for the Italian inflation at 3 and 12 month horizons also the inflationary effects from the other two Euro countries would seem to be important, like the F2 and F3-tests results indicate. An interesting point according to these whole sample results is that Italian inflation would seem to be important factor in affecting inflation in all the analysed countries (including the US), and at all the other horizons, except the 2-year horizon in Germany. However, for example for the US inflation there would not seem to be any feedback relation with the Italian inflation, because the US inflation actually seems to affect only on German and French inflation, and only for the horizons of 1 year or shorter. Finally, the effects of past real activity (both domestic and foreign) on current inflation in each of the analysed countries would seem to be fairly insignificant; only the lagged values of changes in the US industrial production would seem have a more general role in affecting inflation in the Euro3 countries.

From Table A3b we see that, in general, the lagged values of inflation would not seem to have strong effects on current changes in industrial production, except perhaps for the effects of German own inflation, and the effects of Italian inflation on French production. Again, the lags of changes in domestic industrial production are the most important factors in explaining the changes in current production, but now we find that the domestic interest rates (meaning a composite Euro3-area interest rate for each of the European countries and the US rate for the US) have important effects on changes in industrial production.

However, because it seems fairly difficult to find a general pattern of the dependencies and causalitites between the analysed variables that would carry on throughout all the horizons, the next step for the comparison of the VAR-model based forecasts with the ETP forecasts was to extract from each of the systems at different horizons the equations for the inflation and changes in industrial production, and reduce the number of estimated parameters in them by following the implications stemming from the results on the different F-tests reported in Tables A3a and b. Hence, for forecasting purposes the next step was the estimation of the single equations with a moving 5-year window for inflation and changes in industrial production in a form where the insignificant variables were dropped. As an example of the smallest models, among the inflation equations this reduction yield the smallest model for the German 24-month inflation, which in addition to the constant included only the own lagged values of inflation and the lagged values of the changes in the US industrial production. The smallest models among the industrial production equations were for the changes in industrial production in Italy at 3- and 6-month horizons, which included also only the lags of two variables, namely the lagged values of changes in domestic and French industrial productions. Also in cases of the largest models, the number of parameters to be estimated reduced to 29 (for French inflation at 12-month horizon and the US inflation at 3-, 12- and 24-month horizons, and finally for, changes in industrial production in Germany and France at 6-month horizon) instead of the original number of 41, when the constant term is also included in both cases. Thus, when we exclude the irrelevant information in the following forecast exercise, the forecast accuracy and efficiency at all horizons should improve when compared to the starting large VAR spesifications.

Notice that when using this kind of reduction in order to obtain more accurate forecasts from the benchmark models we actually might be working too hard to improve the VAR based forecasts, because it is only supposed to serve as a benchmark model for comparison purposes against ETP forecasts, and in forming the ETP forecasts we actually included all the excess returns and control variables (except the changes in controls) to the models. Another issue that arises in using a VAR model is the choice of the lag length in the model, and for forecasting purposes it is well known that due to the possibility of overparameterization in large VAR spesifications the out-of-sample forecast performance worsens already a priori. However, for the sake of robustness of our results, we shall also report the results on forecasting accuracy based on a full VAR(4) spesification; that is, with 4 lags for each of the variables in each of the equations in the system[19], and compare also the forecasting accuracy of the inflation and industrial production equations based on this spesification against the ETP approach.

[19]Notice that the final competition for choosing the lag length in the VAR spesification was between 2 and 4 lags, and our LR-test results and residual statistics indicated that the lag length of 2 had to be rejected in favour of using 4 lags. Hence, even though the out-of-sample forecasting performance of a full VAR(2) model might clearly be better than for the full VAR(4) model, based on our model statistics we did not consider this very parsimonious VAR specification.

6.5 Results on the out-of-sample forecast performance using a benchmark model

In Table 2 we give the results from a forecasting scheme similar to the previously described ETP exercise, but now using the single equations for inflation and industrial production extracted from a full VAR(4) spesification for forecasting them at different forecast horizons.

Table 2: Out-of-sample forecast error statistics (RMSE = root mean squared errors) from the estimation of the individual forecast equations for inflation and industrial production with a 5-year moving window. Starting bechmark model was a full VAR(4) spesification.

Forecast	Future inflation in				Change in future ind. prod. in			
horizon	ITA	GER	FRA	US	ITA	GER	FRA	US
3	3.07	4.18	2.38	2.92	5.87	13.26	10.01	7.04
6	2.51	5.13	2.94	3.15	6.85	13.91	8.36	7.28
12	3.17	83.73	2.93	2.91	6.74	12.81	6.83	5.93
24	2.81	146.39	13.33	39.56	51.34	10.13	13.61	207.19
$\sum RMSE$	11.58	239.44	21.59	48.54	70.81	50.12	38.82	227.46

Compared to the RMSE values reported in Table 1 we see that both for forecasting future inflation and changes in future industrial production, the RMSE values for the ETP approach are always smaller indicating that the tracking portfolio approach clearly outperforms the full VAR(4) forecasting scheme. Perhaps a better picture from the proportional forecast accuracy of the ETP approach is obtained from Table 3, where we simply report the relative difference between the ETP forecast RMSEs and the benchmark forecast RMSEs.

The proportional forecast accuracy of the ETP model is overwhelming when compared to the benchmark forecasting equations based on full VAR(4) spesifications. Especially for the US and German data, all the different variates of the ETP approach presented in this paper are remarkably better than the simple benchmark model. As a matter of fact, the proportional forecast accuracy of the different ETP versions (panels a, b and c) seems to be almost equally good in all the spesifications when compared to the benchmark model. Furthermore, in line with our previous results we find that when the forecasting horizon increases the proportional forecast accuracy of the ETP model against a benchmark model also strongly improves.

Table 3: Comparison of the proportional forecast accuracy (in %) between the ETP approach and the benchmark forecasts when the starting benchmark model is a full VAR(4) model

a) Using only excess returns in ETP-approach

Forecast horizon	Future inflation in ITA	GER	FRA	US	Change in future ind. prod. in ITA	GER	FRA	US
3	33.88	42.22	33.72	31.84	25.11	41.96	47.55	41.53
6	35.22	60.76	60.82	57.30	43.26	61.07	53.79	54.96
12	59.33	97.81	68.85	57.87	47.28	64.78	48.87	48.62
24	60.82	98.85	95.01	97.70	94.64	65.47	80.04	98.88
$\sum RMSE$	47.72	96.68	80.04	88.73	79.39	57.85	60.52	94.39
b) Using the whole model in ETP-approach								
3	33.07	43.87	20.99	39.24	26.86	33.11	50.35	43.99
6	23.70	54.75	52.29	46.82	39.50	43.15	50.63	52.03
12	59.97	98.51	63.92	51.28	43.82	43.78	30.10	48.52
24	60.96	98.77	93.53	97.39	94.13	48.34	69.67	98.70
$\sum RMSE$	43.55	96.78	75.88	87.84	78.47	41.71	53.62	94.20
c) Using only the control variables in ETP-approach								
3	42.69	48.84	29.94	43.35	32.43	42.90	50.94	50.64
6	27.20	58.90	56.51	52.44	45.09	46.09	56.96	53.02
12	57.12	98.66	66.43	57.05	50.43	48.36	34.57	50.02
24	66.39	98.91	94.49	97.55	94.77	56.70	73.58	98.79
$\sum RMSE$	49.05	97.09	78.38	88.93	80.57	47.97	57.30	94.56

NOTE: The equation for calculating the values in the table is $((RMSE_{VAR(4)} - RMSE_{ETP})/RMSE_{VAR(4)}) \times 100$, where $RMSE_{VAR(4)}$ refers to the VAR(4) model's RMSE value and $RMSE_{ETP}$ to the ETP model's RMSE value.When the value in the table is positive, the ETP forecast is more accurate in terms of RMSEs calculated against the actual future values of the state variable. The higher is the value in the table, the more accurate is the ETP forecast proportionally when compared to benchmark forecast.

For the sake of robustness, we next used benchmark forecasting equations for inflation and industrial production based on restricted VAR(4) spesifications, and the results from there are next reported. Notice that due to our reduction procedure described above, at different forecasting horizons the VAR based forecasting equations may be strikingly different from each other, because the reduction of the models was very different in each horizon and for each country. In fact, except the equations for industrial production in Italy at 3- and 6-month horizons, none of the other forecasting equations based on the reduced VAR(4) approach is similar to any other equation (see Tables A3a and b in the Appendix) but in the ETP approach the models differ only between the versions a), b) and c) reported in Table 1, ie in terms of whether we use only excess returns, the whole model or only the control variables. For each horizon and each country the number of estimated parameters of the ETP model remains the same within modifications a), b) and c) for all countries and horizons.

Table 4: Comparison of the proportional forecast accuracy between the ETP approach and the benchmark forecasts when the starting benchmark model is a VAR(4) model, from which the insignificant variables in the single forecasting equations for inflation and industrial production have been dropped out

Forecast horizon	Future inflation in ITA	GER	FRA	US	Change in future ind. prod. in ITA	GER	FRA	US
	a) Using only excess returns in ETP-approach							
3	-13.49	3.81	0.18	20.40	-2.80	12.05	16.18	14.90
6	-19.47	30.87	-109.83	38.55	-45.32	22.60	27.41	19.17
12	9.79	19.91	69.79	61.71	5.95	56.40	25.94	18.61
24	68.69	53.57	19.41	69.77	52.87	46.53	28.17	58.64
$\sum RMSE$	25.33	29.91	27.97	49.78	11.94	35.29	23.71	29.99
	b) Using the whole model in ETP-approach							
3	-14.89	6.55	-18.97	29.04	-0.39	-1.36	20.67	18.48
6	-40.92	20.29	-155.55	23.48	-54.97	-13.01	22.46	13.89
12	-2.09	45.60	65.00	55.72	-0.21	30.39	-1.22	18.45
24	68.81	50.62	-4.61	65.57	48.42	20.01	-9.17	51.72
$\sum RMSE$	19.38	32.04	12.98	45.81	8.03	10.49	10.38	27.61
	c) Using only the control variables in ETP-approach							
3	1.67	14.82	-5.50	33.84	7.24	13.47	21.61	28.16
6	-34.46	27.60	-132.96	31.56	-40.65	-7.17	32.39	15.67
12	4.89	51.24	67.44	60.96	11.56	36.07	5.23	20.82
24	73.14	56.27	10.92	67.77	54.07	32.95	4.91	55.28
$\sum RMSE$	27.23	38.70	21.99	50.68	16.99	20.11	17.48	32.17

NOTE: (+)/(−)-sign refers to the case where the ETP/benchmark model is more accurate.

Even though for the results reported in Table 4 we have somewhat artificially attempted to improve the forecast performance of the benchmark model by reducing the number of parameters in the benchmark forecast equations the overall superiority of the ETP approach especially at longer horizons is evident also in these results. In panels a and c the financial market variables forecast future inflation better than the reduced benchmark equations in 81% of all the horizons and countries and the forecast performance for changes in future industrial production is better in 87% of the cases. Furthermore, the results in Table 4 clearly indicate that all the versions of the ETP approach are better for forecasting inflation than for forecasting future industrial production, also when compared to the benchmark forecasts based on reduced VAR(4) equations. It also seems that both in Germany and in the US the forecasting scheme based on purely financial market information performs clearly better for all forecast horizons than a benchmark macro model.[20]

Our main overall conclusion from Tables 3–4 is that it is quite possible to forecast the development of future macroeconomy using only current and past financial market information. However, our good out-of-sample performance results might be strongly connected to the fact that here we have adopted an international data set, ie an open economy extension (without any theoretical derivations at the moment) to the previous studies, and on the other hand, attempted to use a smallest possible number of portfolios and control variables right from the beginning. At least for the three core Euro countries and the US, our results indicate that when trying to forecast the development of future inflation, in addition to using macroeconomic structural models, for modern economies the forecasting institutions clearly should somehow utilise the information content of the current and past values of financial (both currency and the stock) market variables, too.

7 Conclusions

The relationship between future values of macroeconomic variables and current financial market returns is among the most interesting research subjects in the financial economists' and finance practitioners' research agenda currently. One of the most recent methods for analysing this relationship is the economic tracking portfolio (ETP) approach utlilised in this study. Previously, among the main problems in this framework has been the poor out-of-sample performance of the tracking portfolio forecasts. Our empirical results indicate that the poor performance could be connected to the use of 'closed economy' financial market data, and a fairly large number of assets in the tracking portfolios. Using an open economy data set in this study, ie, the country specific stock returns and currency returns, yields remarkably good forecasts for future values of inflation and changes in industrial production for the core Euro zone and the US. Already our whole sample estimation results indicated that the information content of our purely financial market based data is high regarding the future development of the analysed macroeconomies.

Our first stage OLS-results also highlighted that the previously not very well discussed role of control variables in the ETP framework seems to be highly relevant, and at least for the German data, their role would seem to be of higher importance than the role of tracking portfolio returns. Namely, for the German macroeconomy and the whole sample of monthly data from 1982:1–2001:6 there was virtually no explanatory power in the tracking portfolio returns (neither currency nor the stock returns) especially for inflation, but the control variables, ie the dividend yields and term spreads at domestic and foreign

[20] See Figures A3 and A4 in the Appendix, which give as an example the figures on future actual values of the macro variables (always the black line in every figure) and the obtained forecasts in Germany and in the US at 3 and 12 month horizons. The graphs further emphasise the main result that the approach using only the financial market information for forecasting future macroeconomy is highly relevant when compared to a benchmark macro VAR approach.

markets seemed highly important in "explaining" the future values of inflation and changes in industrial production. Furthermore, recursive analysis of the data revealed that the tracking and forecasting power of the portfolios, and also the control variables was highly dependent on the country and the forecasting horizon. The forecasting performance of the two versions of the ETP-model, ie the model with control variables and the model without them also seemed to be strongly affected by instability of the coefficients of the model in question. Hence, the final stage of the empirical analysis utilised rolling estimation with a 5-year moving window, and the forecasts from this excercise were compared to the single equation forecasts based on a more traditional simple benchmark macro model with a VAR representation of the data.

The main result from the final stage of our empirical analysis was that it is quite possible to forecast the development of future values of inflation and changes in industrial production in the core Euro zone and especially in the US using only the current and past financial market data. However, the role of foreign market effects would seem to be highly relevant in this respect. Furthermore, one of the most striking results in our study is the increasing superiority of the financial information forecasting models when compared to the competing macro VAR based spesifications when the time horizon in the forecasting scheme increases. Especially in the two-year forecast horizon for the US and German data on inflation, the financial market based forecasting model was extremely good.

Further research on the theme in this paper is obviously necessary. Regarding our current data set, there are at least two main streams for forthcoming studies on the subject. The use of industry level international stock market data in the ETP approach migh give answers to the questions of hedging abilities at different horizons of the different industry portfolios against inflation and real activity risks. Furthermore, the role of control variables seemed highly relevant in our forecasting exercises and hence, the analysis for a possibility of somewhat more structurally defined relationships between the current values of financial market variables and the future development of the macroeconomy could start from defining some kind of structural systems of equations for the macro variables and the controls found to be relevant in this study, for example.

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Appendix Tables and figures

Table A1. **Correlation between the excess returns and future macro values, returns measured as monthly log changes in the price index times 12 (in %). Correlations over 0.2 in absolute value highlighted.**

Italy

	Excess currency returns			Excess stock returns			
Macro variables	**ITA**	**DEM**	**FRA**	**ITA**	**DEM**	**FRA**	**US**
INF3	-0.176	-0.020	-0.148	-0.084	0.008	-0.085	-0.030
INF6	-0.198	-0.044	-0.177	-0.152	-0.026	-0.124	-0.059
INF12	-0.221	-0.066	-0.203	-0.157	-0.050	-0.128	-0.094
INF24	-0.205	-0.065	-0.205	-0.144	-0.043	-0.104	-0.120
PROD3	0.157	0.111	0.156	0.024	0.009	0.029	-0.088
PROD6	0.179	0.124	0.170	0.076	0.047	0.053	-0.097
PROD12	0.180	0.131	0.175	0.091	0.065	0.068	-0.067
PROD24	0.125	0.090	0.110	0.122	0.055	0.064	-0.060

Germany

	Excess currency returns			Excess stock returns			
Macro variables	**ITA**	**DEM**	**FRA**	**ITA**	**DEM**	**FRA**	**US**
INF3	-0.154	-0.138	-0.131	-0.104	-0.058	-0.066	0.002
INF6	-0.241	-0.166	-0.167	-0.197	-0.118	-0.124	-0.057
INF12	-0.218	-0.200	-0.194	-0.269	-0.186	-0.176	-0.077
INF24	-0.095	-0.096	-0.087	-0.245	-0.160	-0.150	-0.080
PROD3	0.033	-0.017	-0.012	0.032	0.025	0.030	-0.004
PROD6	0.086	-0.019	0.016	0.078	0.065	0.028	0.044
PROD12	0.010	-0.068	-0.069	0.045	0.012	-0.044	-0.017
PROD24	0.024	-0.011	-0.015	0.072	0.036	0.037	0.015

France

	Excess currency returns			Excess stock returns			
Macro variables	**ITA**	**DEM**	**FRA**	**ITA**	**DEM**	**FRA**	**US**
INF3	-0.243	-0.120	-0.222	-0.023	0.029	-0.015	0.002
INF6	-0.207	-0.073	-0.210	-0.075	-0.012	-0.049	-0.013
INF12	-0.218	-0.090	-0.233	-0.129	-0.043	-0.098	-0.062
INF24	-0.197	-0.065	-0.212	-0.116	-0.025	-0.082	-0.082
PROD3	0.133	0.084	0.103	0.044	-0.012	0.004	-0.041
PROD6	0.088	-0.006	0.034	0.046	0.015	-0.024	0.019
PROD12	0.031	-0.063	-0.040	0.064	-0.000	-0.012	0.052
PROD24	0.058	0.005	0.014	0.099	-0.001	0.031	0.043

The US

	Excess currency returns			Excess stock returns			
Macro variables	**ITA**	**DEM**	**FRA**	**ITA**	**DEM**	**FRA**	**US**
INF3	-0.083	-0.033	-0.072	-0.087	0.024	-0.030	-0.052
INF6	-0.056	-0.012	-0.039	-0.079	-0.031	0.012	-0.113
INF12	-0.021	-0.009	-0.050	-0.148	-0.072	-0.059	-0.119
INF24	0.015	0.065	-0.004	-0.084	-0.022	-0.010	-0.086
PROD3	-0.024	-0.054	-0.027	0.075	0.100	0.108	0.087
PROD6	-0.007	-0.025	-0.016	0.087	0.122	0.109	0.129
PROD12	-0.036	-0.056	-0.088	0.023	0.006	0.001	0.162
PROD24	-0.038	0.000	-0.047	0.040	0.040	0.012	0.138

Correlation matrix for the excess returns

	Excess returns on currency portfolios			Excess returns on stock portfolios			
	EXCITA	**EXCDEM**	**EXCFRA**	**EXSITA**	**EXSDEM**	**EXSFRA**	**EXSUS**
EXCRITA	1.000	0.854	0.859	0.321	0.306	0.272	-0.067
EXCDEM	***	1.000	0.954	0.157	0.325	0.298	-0.092
EXCFRA	***	***	1.000	0.164	0.294	0.321	-0.071
EXSITA	***	***	***	1.000	0.503	0.541	0.303
EXSDEM	***	***	***	***	1.000	0.702	0.437
EXSFRA	***	***	***	***	***	1.000	0.509
EXSUS	***	***	***	***	***	***	1.000

Correlations between macro variables and lagged controls

Italy

	Lagged dividend yields				Lagged term spreads			
Macro variables	**ITA**	**DEM**	**FRA**	**US**	**ITA**	**DEM**	**FRA**	**US**
INF3	0.216	0.801	0.761	0.687	-0.347	-0.025	-0.495	0.023
INF6	0.231	0.857	0.799	0.721	-0.378	-0.032	-0.496	-0.004
INF12	0.248	0.872	0.813	0.720	-0.468	-0.064	-0.564	-0.019
INF24	0.253	0.895	0.846	0.727	-0.483	-0.087	-0.576	-0.068
PROD3	-0.108	-0.044	-0.111	-0.042	0.085	0.276	0.368	-0.070
PROD6	-0.053	-0.091	-0.148	-0.082	0.079	0.299	0.374	-0.071
PROD12	0.069	-0.169	-0.196	-0.130	0.068	0.311	0.342	-0.031
PROD24	0.271	-0.213	-0.206	-0.089	-0.081	0.292	0.217	0.053

Germany

	Lagged dividend yields				Lagged term spreads			
Macro variables	**ITA**	**DEM**	**FRA**	**US**	**ITA**	**DEM**	**FRA**	**US**
INF3	0.151	0.510	0.402	0.300	-0.041	-0.415	-0.219	0.088
INF6	0.196	0.611	0.496	0.359	0.014	-0.494	-0.250	0.106
INF12	0.220	0.689	0.549	0.418	0.047	-0.574	-0.322	0.102
INF24	0.225	0.666	0.526	0.416	0.001	-0.613	-0.331	-0.102
PROD3	0.068	-0.186	-0.121	-0.131	0.115	0.278	0.193	-0.127
PROD6	0.095	-0.254	-0.177	-0.162	0.150	0.388	0.219	-0.209
PROD12	0.121	-0.277	-0.201	-0.160	-0.027	0.435	0.144	-0.364
PROD24	0.020	-0.212	-0.135	-0.132	-0.157	0.550	0.147	-0.340

France

	Lagged dividend yields				Lagged term spreads			
Macro variables	**ITA**	**DEM**	**FRA**	**US**	**ITA**	**DEM**	**FRA**	**US**
INF3	0.172	0.864	0.817	0.716	-0.438	0.072	-0.462	0.017
INF6	0.186	0.895	0.839	0.737	-0.435	0.084	-0.525	-0.009
INF12	0.191	0.892	0.838	0.731	-0.468	0.055	-0.552	-0.100
INF24	0.204	0.887	0.849	0.726	-0.498	0.042	-0.550	-0.151
PROD3	0.085	-0.182	-0.117	-0.184	0.142	0.272	0.281	-0.043
PROD6	0.118	-0.256	-0.169	-0.241	0.211	0.394	0.375	-0.136
PROD12	0.150	-0.266	-0.148	-0.236	0.074	0.450	0.299	-0.175
PROD24	0.015	-0.250	-0.126	-0.261	-0.007	0.494	0.277	-0.090

The US

	Lagged dividend yields				Lagged term spreads			
Macro variables	**ITA**	**DEM**	**FRA**	**US**	**ITA**	**DEM**	**FRA**	**US**
INF3	0.113	0.646	0.550	0.505	-0.267	-0.074	-0.165	-0.153
INF6	0.140	0.686	0.586	0.526	-0.300	-0.062	-0.173	-0.173
INF12	0.201	0.692	0.602	0.533	-0.272	-0.073	-0.246	-0.276
INF24	0.289	0.675	0.619	0.520	-0.401	-0.072	-0.238	-0.307
PROD3	0.108	-0.276	-0.187	-0.274	0.206	0.317	0.073	0.309
PROD6	0.148	-0.300	-0.215	-0.297	0.228	0.309	0.009	0.290
PROD12	0.176	-0.325	-0.213	-0.284	0.208	0.244	-0.127	0.205
PROD24	0.061	-0.278	-0.122	-0.260	0.183	0.097	-0.141	0.223

Correlations between the excess returns and lagged controls

	Lagged dividend yields				Lagged terms spreads			
Excess returns	**ITA**	**DEM**	**FRA**	**US**	**ITA**	**DEM**	**FRA**	**US**
EXCRETITA	-0.024	-0.117	-0.082	-0.036	-0.071	0.056	0.034	0.018
EXCRETDEM	-0.046	0.021	0.017	0.046	-0.003	0.078	-0.028	0.036
EXCRETFRA	-0.045	-0.076	-0.077	-0.021	-0.017	0.087	0.068	0.023
EXCRETUS	0.012	0.036	-0.001	0.032	0.064	0.051	-0.006	-0.003
EXCREXITA	-0.169	-0.244	-0.232	-0.130	0.117	0.041	0.153	-0.056
EXCREXDEM	-0.128	-0.108	-0.092	0.020	0.014	-0.001	0.064	0.060
EXCREXFRA	-0.121	-0.223	-0.227	-0.108	0.109	-0.021	0.181	0.063

Table A2a. **The full sample (starting from 1982:3) OLS parameter estimates when estimating the ETP-model for inflation. Standard errors have been computed using the Newey-West procedure with 24 lags in all cases. Only the parameter estimates significant at lower than or equal to 10% risk level have been reported.**

i) Italy and France

	Inflation at *k* horizon in							
	Italy				France			
Excess currency returns in	***k* = 3**	***k* = 6**	***k* = 12**	***k* = 24**	***k* = 3**	***k* = 6**	***k* = 12**	***k* = 24**
ITA	-0.023***	-0.011***	-0.007*	--	-0.016***	-0.011***	-0.004*	--
DEM	0.020**	--	--	--	--	--	--	--
FRA	--	--	--	--	--	--	--	--
Excess stock returns in								
ITA	0.003***	--	--	--	0.003**	0.002*	--	--
DEM	--	--	--	--	--	-0.002**	-0.002*	-0.001**
FRA	--	--	--	--	--	--	0.002**	--
US	-0.006***	-0.005***	-0.004***	-0.005***	--	--	-0.003***	-0.002**
Controls								
a) the stock market								
DYITA	--	--	--	-0.517***	--	--	--	-0.458***
DYDEM	--	--	--	1.201**	--	--	1.096*	1.107***
DYFRA	1.364***	1.071***	0.469**	--	--	--	--	--
DYUS	1.860***	1.757***	1.607***	1.488***	0.584*	0.736***	0.818***	0.786***
CHDYITA	--	--	0.635***	0.633***	--	--	0.644**	0.644***
CHDYDEM	--	--	--	-0.846*	--	--	--	-0.585**
CHDYFRA	-1.019***	-0.670***	-0.331*	--	-0.821**	-0.666***	-0.563***	-0.242*
CHDYUS	--	--	--	--	--	--	--	--
b) the bond market								
SPREADITA	0.528***	0.371***	--	--	--	--	--	--
SPREADDEM	--	--	--	--	0.495***	0.489***	0.314***	0.162*
SPREADFRA	--	--	-0.155*	-0.184***	-0.359***	-0.396***	-0.283***	-0.187***
SPREADUS	-0.757***	-0.569***	-0.329***	-0.227**	-0.296*	-0.338***	-0.331***	-0.214***
CHSPITA	-0.472***	--	--	--	-0.263***	-0.286***	-0.164***	-0.073*
CHSPDEM	--	--	--	0.382*	--	--	--	--
CHSPFRA	--	--	--	0.112***	0.195***	0.218***	0.150***	0.119***
CHSPUS	0.753***	--	--	--	--	--	0.368**	0.333***
CONSTANT	-2.860***	-2.542***	-1.501**	-0.710*	-2.444**	-2.541***	-1.979***	-1.323***
Wald1	56.091	16.131	4.087	1.675	7.998	11.334	4.289	7.116
	(0.000)	(0.001)	(0.252)	(0.642)	(0.046	(0.010)	(0.231)	(0.068)
Wald2	10.983	0.144	0.432	1.731	4.946	11.948	4.540	4.728
	(0.011)	(0.986)	(0.933)	(.630)	(0.175)	(0.007)	(0.208)	(0.192)
Wald3	8.178	12.732	12.234	8.804	1.207	1.301	6.798	3.970
	(0.004)	(0.000)	(0.000)	(0.003)	(0.271)	(0.253)	(0.009)	(0.046)
Wald4	87.980	71.446	50.019	29.224	12.197	17.196	23.558	13.774
	(0.000)	(0.000)	(0.000)	(0.000)	(0.094)	(0.016)	(0.001)	(0.055)

NOTES: *, ** and *** refer to significant t-statistics at 10, 5 and 1% risk levels, respectively. Notice that for all the control variables the model implies the use of one period lagged values. Wald1 refers to the Wald-test statistics when testing for the null that all the ETP-weights on Euro-currencies are jointly zero (significance of the whole currency portfolio), Wald2 to the test of all the ETP-weights of Euro stocks being zero (significance of Euro stock portfolio), Wald3 to the test of the US stock weight being zero, and finally, Wald4 is the test for the significance of all the ETP-weights (for both currencies and stocks) jointly being zero. Marginal significance levels are given in parenthesis.

Table A2a continues

ii) Germany and the US

	Inflation at *k* horizon in							
	Germany				US			
Excess currency returns in	***k* = 3**	***k* = 6**	***k* = 12**	***k* = 24**	***k* = 3**	***k* = 6**	***k* = 12**	***k* = 24**
ITA	--	--	0.005*	--	--	--	--	--
DEM	--	--	--	--	--	--	--	0.008**
FRA	--	--	--	--	--	--	--	-0.006**
Excess stock returns in								
ITA	--	--	-0.003***	-0.002***	--	--	-0.001*	--
DEM	--	--	--	--	--	--	--	--
FRA	--	--	0.002**	--	--	0.002*	0.002***	0.001**
US	--	--	-0.002*	-0.001*	--	-0.003**	-0.003***	-0.002**
Controls								
a) the stock market								
DYITA	0.861***	1.139***	0.896***	0.639**	--	--	--	-0.569***
DYDEM	--	--	1.221*	--	--	1.684*	2.130***	2.194***
DYFRA	0.807***	0.592***	--	-0.319**	-0.854*	-1.278***	-1.482***	-1.332***
DYUS	-0.806***	-0.705**	-0.563*	--	--		0.391*	0.411***
CHDYITA	--		--	--	--		--	0.266*
CHDYDEM	--		--	--	-1.962*	-1.700***	-1.178***	-1.188***
CHDYFRA	-0.961***	-0.457***	-0.338***	--	0.630*	0.542***	0.502***	0.563***
CHDYUS	--	--	--	--	2.076*	1.304***	0.819***	0.475**
b) the bond market								
SPREADITA	--	--	0.152*	--	--	--	--	--
SPREADDEM	-0.606***	-0.544**	-0.451***	-0.474***	--	--	--	--
SPREADFRA	--	--	--	--	--	--	-0.215***	-0.096**
SPREADUS	--	--	-0.230*	-0.481***	-0.319**	-0.331**	-0.423***	-0.269***
CHSPITA	0.269**	--	--	--	0.484**	--	-0.108**	-0.057**
CHSPDEM	-0.838**	--	0.431*	0.903***	--	--	0.428**	--
CHSPFRA	-0.165*	--	--	--	--	--	0.156***	0.107***
CHSPUS	--	--	--	--	--	--	--	--
CONSTANT	--	--	--	1.071*	1.913*	1.593*	1.838***	2.008***
Wald1	5.768	1.581	5.666	11.265	1.408	0.551	2.430	6.475
	(0.123)	(0.663)	(0.129)	(0.010)	(0.704)	(0.907)	(0.488)	(0.090)
Wald2	1.468	2.970	23.773	22.027	1.981	3.806	10.536	7.900
	(0.689)	(0.396)	(0.000)	(0.000)	(0.576)	(0.283)	(0.015)	(0.048)
Wald3	0.088	1.731	3.457	3.507	0.544	4.076	12.692	5.821
	(0.766)	(0.188)	(0.062)	(0.061)	(0.461)	(0.043)	(0.000)	(0.016)
Wald4	9.825	30.437	60.926	42.716	7.665	15.619	66.451	48.815
	(0.198)	(0.000)	(0.000)	(0.000)	(0.363)	(0.029)	(0.000)	(0.000)

NOTES: See part i) of the table

Table A2b. **The full sample parameter estimates from the simple OLS-results when estimating the ETP-model for future changes in industrial production**

i) Italy and France

	Change in industrial production at *k* in							
	Italy				France			
Excess currency returns in	***k = 3***	***k = 6***	***k = 12***	***k = 24***	***k* = 3**	***k = 6***	***k = 12***	***k* = 24**
ITA	--	--	--	--	--	--	--	--
DEM	--	--	--	--	--	--	--	--
FRA	--	--	--	--	--	--	--	--
Excess stock returns in								
ITA	--	--	--	0.003**	--	--	--	0.003*
DEM	--	--	--	--	--	--	--	-0.003*
FRA	--	--	--	--	--	-0.006*	--	--
US	-0.010***	-0.011***	-0.008**	-0.006***	--	--	--	--
Controls								
a) the stock market								
DYITA	--	--	--	-1.727***	--	--	--	-1.404***
DYDEM	--	--	--	3.274***	--	--	2.841***	3.090***
DYFRA	-2.966***	-3.103***	-3.393***	-3.350***	--	--	-1.188***	-0.735***
DYUS	3.832***	3.509***	2.808***	1.387***	--	--	--	-1.318***
CHDYITA	--	--	--	--	-2.718**	--	--	--
CHDYDEM	--	--	--	-2.879***	--	--	--	--
CHDYFRA	1.459***	1.733***	1.668***	1.644***	--	1.014*	1.163***	0.584***
CHDYUS	--	2.645**	1.891**	1.791***	--	--	--	--
b) the bond market								
SPREADITA	--	--	--	--	--	--	--	-0.278*
SPREADDEM	--	--	--	0.528**	0.787*	0.735*	0.890***	0.790***
SPREADFRA	0.455**	0.326*	--	--	--	0.225*	--	--
SPREADUS	--	--	--	--	--	--	--	0.365**
CHSPITA	--	--	--	-0.168**	-1.039***	--	--	--
CHSPDEM	--	1.786*	1.429**	0.748**	--	--	--	--
CHSPFRA	--	--	--	0.272***	--	--	0.197*	0.196*
CHSPUS	--	--	--	--	--	0.922**	--	--
CONSTANT	--	--	--	--	--	--	2.812*	3.363***
Wald1	8.037	13.759	7.982	9.359	0.724	0.465	0.777	0.037
	(0.045)	(0.003)	(0.046)	(0.024)	(0.859)	(0.926)	(0.855)	(0.998)
Wald2	1.597	3.511	4.274	7.234	0.756	4.529	7.202	8.202
	(0.660)	(0.319)	(0.233)	(0.064)	(0.859)	(0.209)	(0.066)	(0.042)
Wald3	9.666	12.705	6.130	8.641	0.265	0.104	0.615	0.875
	(0.001)	(0.000)	(0.013)	(0.003)	(0.606)	(0.746)	(0.432)	(0.349)
Wald4	22.784	27.391	12.704	13.480	3.223	6.023	19.123	18.305
	(0.001)	(0.000)	(0.079)	(0.061)	(0.863)	(0.537)	(0.007)	(0.010)

See Table A2a for the notes.

Table A2b continues

ii) Germany and the US

	Change in industrial production at *k* horizon in							
	Germany				US			
Excess currency returns in	***k = 3***	***k = 6***	***k = 12***	***k = 24***	***k* = 3**	***k = 6***	***k = 12***	***k* = 24**
ITA	--	--	--	-0.014*	--	--	--	--
DEM	--	--	--	-0.018*	-0.037*	--	--	--
FRA	-0.081	--	--	0.030**	--	--	--	--
Excess stock returns in								
ITA	--	--	0.006*	0.005*	--	--	--	--
DEM	--	--	--	--	--	--	-0.008***	-0.003***
FRA	--	--	-0.006*	--	0.005*	--	--	--
US	--	--	--	--	--	--	0.009***	0.007***
Controls								
a) the stock market								
DYITA	--	--	--	-1.585**	--	--	-1.821***	-1.303***
DYDEM	--	--	3.869***	5.071***	--	--	3.352***	--
DYFRA	-2.625***	-3.085***	-2.822***	-2.143***	--	--	0.943*	2.282***
DYUS	--	1.882*	--	--	-2.158***	-2.572***	-2.506***	-1.776***
CHDYITA	--	--	--	--	--	1.698*	2.108**	1.183***
CHDYDEM	--	-4.273*	-5.445***	-2.757**	-7.200***	-4.415**	--	--
CHDYFRA	2.794*	1.667*	1.600***	0.875***	--	--	-0.800***	-1.061***
CHDYUS	--	--	3.352***	--	--	--	-2.178**	-1.673***
b) the bond market								
SPREADITA	--	--	--	--	--	--	--	--
SPREADDEM	1.709***	1.691***	1.521***	1.438***	1.958***	1.729***	0.997***	--
SPREADFRA	--	-0.552***	-0.491***	-0.436***	-0.872***	-0.920***	-0.648***	--
SPREADUS	-1.563***	-1.540***	-1.413***	-0.478**	1.940***	1.525***	1.177***	0.916***
CHSPITA	-1.387***	-0.926**	-0.468**	-0.301***	--	-0.572***	-0.355**	--
CHSPDEM	3.508**	4.319**** *	2.479**	--	--	--	--	--
CHSPFRA	1.241***	0.932***	0.635***	0.545***	0.549***	0.689***	0.387***	--
CHSPUS	--	--	--	--	--	1.293*	1.236***	0.429**
CONSTANT	--	--	--	--	5.700***	4.242***	4.505***	6.216***
Wald1	6.081	2.283	3.069	6.782	3.146	1.421	2.367	10.290
	(0.107)	(0.515)	(0.381)	(0.079)	(0.369)	(0.700)	(0.500)	(0.016)
Wald2	0.463	3.788	6.053	3.576	5.823	1.893	15.190	10.582
	(0.926)	(0.285)	(0.109)	(0.310)	(0.120)	(0.595)	(0.001)	(0.014)
Wald3	0.099	0.111	1.186	1.318	0.180	1.794	16.396	23.451
	(0.752)	(0.738)	(0.276)	(0.250)	(0.671)	(0.180)	(0.000)	(0.000)
Wald4	7.717	5.163	19.435	12.185	10.678	8.783	45.000	31.763
	(0.358)	(0.639)	(0.006)	(0.094)	(0.153)	(0.269)	(0.000)	(0.000)

NOTES: See Table A2a.

Table A2c. **The full sample parameter estimates from the simple OLS-results when estimating the ETP-model for future inflation without the control variables. Standard errors have been computed using the Newey-West procedure with 24 lags in all cases. Only the parameter estimates significant at lower than or equal to 10% risk level have been reported.**

	Inflation at *k* horizon in							
	Italy				**France**			
Excess currency returns in	***k = 3***	***k = 6***	***k = 12***	***k = 24***	***k* = 3**	***k* = 6**	***k* = 12**	***k* = 24**
ITA	-0.038*	--		--	--	--	--	--
DEM	0.137***	0.128***	0.114***	0.095***	0.081***	0.089***	0.086***	0.074***
FRA	-0.110***	-0.110***	-0.101***	-0.089***	-0.070***	-0.080***	-0.084***	-0.071***
Excess stock returns in								
ITA	--	--	--	--	--	--	--	--
DEM	--	--	--	--	--	--	--	--
FRA	--	--	--	--	--	--	--	--
US	--	--	--	--	--	--	--	--
CONSTANT	4.598***	4.632***	4.582***	4.533***	2.454***	2.453***	2.445***	2.374***
Wald1	13.111	13.348	15.192	16.937	17.008	20.139	25.153	19.745
	(0.004)	(0.003)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Wald2	1.225	2.806	1.603	1.926	4.197	1.224	3.030	1.967
	(0.746)	(0.422)	(0.658)	(0.587)	(0.240)	(0.747)	(0.386)	(0.579)
Wald3	0.004	0.053	0.743	1.836	0.413	0.022	0.463	0.877
	(0.944)	(0.817)	(0.388)	(0.175)	(0.520)	(0.881)	(0.495)	(0.348)
Wald4	33.454	38.899	38.107	40.296	31.964	24.784	44.191	43.994
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

	Germany				**US**			
Excess currency returns in	***k = 3***	***k = 6***	***k = 12***	***k = 24***	***k* = 3**	***k* = 6**	***k* = 12**	***k* = 24**
ITA	--	--		--	--	--	0.005*	--
DEM	--	--	--	--	0.018*	--	--	0.016**
FRA	--	--	--	--	-0.018*	--	-0.015**	-0.017***
Excess stock returns in								
ITA	--	--	-0.004**	-0.004**	--	-0.002*	-0.002***	-0.001*
DEM	--	--	--	--	--	--	--	--
FRA	--	--	--	--	--	--	0.002**	0.002*
US	--	--	--	--	--	--	-0.002*	--
CONSTANT	2.162***	2.065***	2.142***	2.172***	3.125***	3.173***	3.200***	3.157***
Wald1	2.495	6.640	6.403	1.805	3.912	3.182	11.619	14.971
	(0.476)	(0.084)	(0.093)	(0.613)	(0.271)	(0.364)	(0.009)	(0.002)
Wald2	0.661	1.072	4.827	5.992	3.357	6.067	18.295	7.530
	(0.882)	(0.783)	(0.184)	(0.111)	(0.340)	(0.108)	(0.000)	(0.057)
Wald3	0.005	0.494	0.355	0.039	0.515	2.511	3.207	1.254
	(0.940)	(0.481)	(0.551)	(0.843)	(0.473)	(0.113)	(0.073)	(0.263)
Wald4	5.982	14.688	18.795	15.873	17.815	13.852	32.237	26.985
	(0.541)	(0.040)	(0.008)	(0.026)	(0.013)	(0.054)	(0.000)	(0.000)

NOTES: See Table A2a.

Table A2d. **The full sample parameter estimates from the simple OLS-results when estimating the ETP-model for changes in future industrial production without the control variables. Standard errors have been computed using the Newey-West procedure with 24 lags in all cases. Only the parameter estimates significant at lower than or equal to 10% risk level have been reported.**

	Change in industrial production at *k* horizon in							
	Italy				**France**			
Excess currency returns in	***k = 3***	***k = 6***	***k = 12***	***k = 24***	***k = 3***	***k = 6***	***k = 12***	***k = 24***
ITA	--	--	--	--	--	--	0.018**	--
DEM	--	--	--	--	--	-0.050**	--	--
FRA	--	--	--	--	--	--	--	--
Excess stock returns in					--			
ITA	--	--	--	--		--	--	--
DEM	--	--	--	--	--	--	--	--
FRA	--	--	--	--	--	--	--	--
US	-0.008**	-0.010**	-0.007*	--	--	--	--	--
CONSTANT	2.060***	2.066***	2.100***	2.086***	2.119***	2.048***	1.906***	1.797***
Wald1	5.926	4.348	3.444	0.658	6.309	5.355	5.634	0.399
	(0.115)	(0.226)	(0.328)	(0.882)	(0.097)	(0.147)	(0.130)	(0.940)
Wald2	0.391	1.610	2.288	3.471	0.387	2.361	1.066	2.228
	(0.941)	(0.657)	(0.514)	(0.324)	(0.942)	(0.500)	(0.785)	(0.526)
Wald3	4.237	5.382	3.676	2.550	0.336	0.286	0.745	0.710
	(0.039)	(0.020)	(0.055)	(0.110)	(0.562)	(0.592)	(0.387)	(0.399)
Wald4	13.402	18.552	14.286	28.172	6.844	8.722	11.525	18.802
	(0.062)	(0.009)	(0.046)	(0.000)	(0.445)	(0.273)	(0.117)	(0.008)

	Germany				**US**			
Excess currency returns in	***k = 3***	***k = 6***	***k = 12***	***k = 24***	***k = 3***	***k = 6***	***k = 12***	***k = 24***
ITA	--	0.048**	0.026**	--	--	--	--	--
DEM	--	-0.080**	--	--	--	--	--	--
FRA	--	--	--	--	--	--	--	--
Excess stock returns in								
ITA	--	--	--	--	--	--	--	--
DEM	--	0.008*	--	--	--	--	--	--
FRA	--	--	--	--	--	--	--	--
US	--	--	--	--	--	--	0.013**	0.008***
CONSTANT	2.242***	2.552***	2.255**	2.030**	3.345***	3.359***	3.482***	3.361***
Wald1	2.623	8.874	7.611	1.134	2.921	0.742	2.986	2.400
	(0.453)	(0.031)	(0.054)	(0.768)	(0.403)	(0.863)	(0.394)	(0.494)
Wald2	1.506	2.862	1.962	0.505	2.496	1.876	2.312	2.301
	(0.680)	(0.413)	(0.580)	(0.917)	(0.476)	(0.599)	(0.510)	(0.512)
Wald3	0.590	0.065	0.168	0.112	0.002	1.135	5.436	11.992
	(0.442)	(0.797)	(0.681)	(0.737)	(0.964)	(0.287)	(0.019)	(0.000)
Wald4	3.961	11.519	26.500	14.167	4.745	4.116	15.736	17.720
	(0.784)	(0.117)	(0.000)	(0.048)	(0.691)	(0.766)	(0.028)	(0.013)

NOTES: See Table A2a.

Table A3. **Coefficient of determination and F-test results from a benchmark VAR model estimated for the whole sample (1982:3–2000:12); results on the equation on**

	a) annualised *k*-month inflation in							
	Italy				**France**			
Model statistics	***k = 3***	***k = 6***	***k = 12***	***k = 24***	$k = 3$	***k = 6***	***k = 12***	***k = 24***
R^2	0.94	0.98	0.99	0.99	0.92	0.97	0.99	0.99
Sum of coefficients on own lags	0.72	0.75	0.90	0.91	0.76	0.82	0.87	0.88
F1	**154.58**	**240.75**	**548.68**	**404.92**	**3.71**	**3.77**	**2.61**	**2.76**
	(0.00)	**(0.00)**	**(0.00)**	**(0.00)**	**(0.00)**	**(0.00)**	**(0.03)**	**(0.02)**
F2	**3.13**	1.81	**4.00**	1.55	**3.08**	**2.56**	1.67	1.51
	(0.01)	(0.12)	**(0.00)**	(0.18)	**(0.01)**	**(0.03)**	(0.15)	(0.19)
F3	**4.21**	**7.14**	**4.25**	**4.32**	**77.17**	**128.13**	**223.00**	**223.66**
	(0.00)	**(0.00)**	**(0.00)**	**(0.00)**	**(0.00)**	**(0.00)**	**(0.00)**	**(0.00)**
F4	0.62	1.14	0.34	**2.62**	**4.27**	**4.37**	**3.50**	1.80
	(0.64)	(0.33)	(0.84)	**(0.03)**	**(0.00)**	**(0.00)**	**(0.00)**	(0.12)
F5	0.45	1.31	**2.54**	1.94	1.16	1.54	**6.02**	1.71
	(0.77)	(0.26)	**(0.04)**	(0.10)	(0.32)	(0.19)	**(0.00)**	(0.14)
F6	1.22	1.36	**4.61**	**2.71**	0.12	0.42	0.68	0.73
	(0.30)	(0.24)	**(0.00)**	**(0.03)**	(0.97)	(0.79)	(0.60)	(0.56)
F7	1.17	1.56	1.64	**2.61**	0.82	1.56	**3.77**	1.09
	(0.32)	(0.18)	(0.16)	**(0.03)**	(0.51)	(0.18)	**(0.00)**	(0.35)
F8	**6.10**	**3.61**	2.21	**2.36**	1.26	1.96	**5.07**	2.06
	(0.00)	**(0.00)**	(0.06)	**(0.05)**	(0.28)	(0.10)	**(0.00)**	(0.08)
F9	2.04	0.95	0.99	0.32	1.90	1.94	0.88	0.42
	(0.09)	(0.43)	(0.41)	(0.86)	(0.11)	(0.10)	(0.47)	(0.78)
F10	**2.42**	1.04	1.05	0.47	0.96	**3.16**	**3.29**	0.57
	(0.04)	(0.38)	(0.37)	(0.75)	(0.42)	**(0.01)**	**(0.01)**	(0.68)

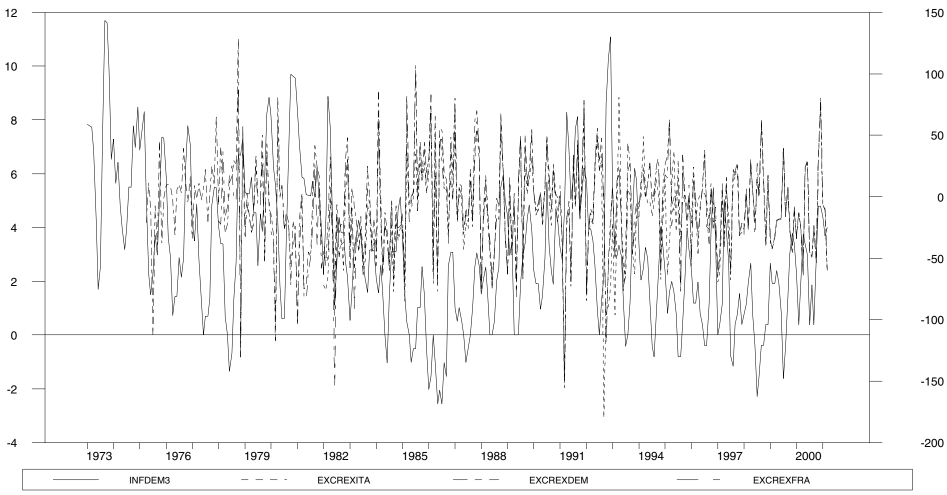
	Germany				**US**			
R^2	0.76	0.87	0.97	0.99	0.82	0.88	0.96	0.99
Sum of coefficients on own lags	0.76	0.80	0.95	0.94	0.62	0.78	0.87	0.84
F1	**6.95**	**5.81**	**5.11**	1.28	**8.43**	**8.10**	**8.13**	**8.27**
	(0.00)	**(0.00)**	**(0.00)**	(0.27)	**(0.00)**	**(0.00)**	**(0.00)**	**(0.00)**
F2	**83.38**	**134.63**	**318.30**	**389.93**	**2.89**	0.56	**2.45**	**3.76**
	(0.00)	**(0.00)**	**(0.00)**	**(0.00)**	**(0.02)**	(0.68)	**(0.04)**	**(0.00)**
F3	0.71	**3.22**	**2.99**	1.12	**5.02**	**3.16**	2.08	**3.82**
	(0.58)	**(0.01)**	**(0.01)**	(0.34)	**(0.00)**	**(0.01)**	(0.08)	**(0.00)**
F4	**4.38**	**2.43**	**3.64**	2.18	**75.22**	**127.51**	**222.75**	**202.46**
	(0.00)	**(0.04)**	**(0.00)**	(0.07)	**(0.00)**	**(0.00)**	**(0.00)**	**(0.00)**
F5	1.28	0.79	0.71	0.69	**2.82**	1.99	**2.33**	**4.93**
	(0.27)	(0.52)	(0.58)	(0.59)	**(0.02)**	(0.09)	**(0.05)**	**(0.00)**
F6	1.23	0.46	2.07	1.02	0.15	0.24	1.70	1.38
	(0.29)	(0.76)	(0.08)	(0.29)	(0.95)	(0.91)	(0.14)	(0.23)
F7	0.20	0.70	2.06	0.92	0.11	0.66	**4.88**	**6.54**
	(0.93)	(0.59)	(0.08)	(0.45)	(0.97)	(0.61)	**(0.00)**	**(0.00)**
F8	0.39	1.74	**2.89**	**4.74**	1.15	0.90	**3.09**	1.30
	(0.80)	(0.14)	**(0.02)**	**(0.00)**	(0.33)	(0.46)	**(0.01)**	(0.27)
F9	**3.20**	**5.07**	0.71	1.13	**3.08**	**2.90**	**2.90**	0.69
	(0.01)	**(0.00)**	(0.58)	(0.34)	**(0.01)**	**(0.02)**	**(0.02)**	(0.59)
F10	0.88	0.29	0.14	0.30	**2.67**	1.21	1.78	**4.36**
	(0.47)	(0.88)	(0.96)	(0.87)	**(0.03)**	(0.30)	(0.13)	**(0.00)**

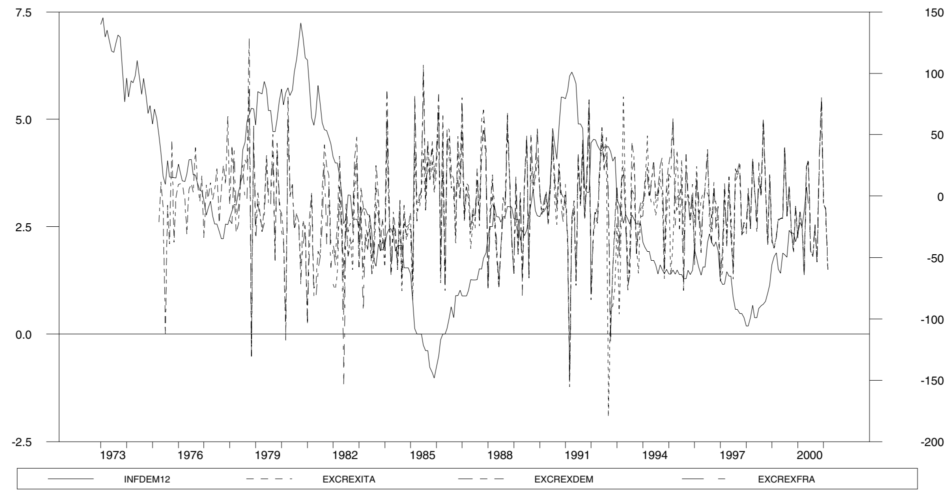
	b) annualised *k*-month change in industrial production in							
		Italy				France		
Model statistics	***k = 3***	***k = 6***	***k = 12***	***k = 24***	*k* = 3	***k = 6***	***k = 12***	***k* = 24**
R^2	0.86	0.95	0.98	0.99	0.56	0.70	0.83	0.91
Sum of coefficients on own lags	0.85	0.90	0.93	0.93	0.13	0.51	0.64	0.75
F1	0.33	0.07	0.14	1.97	**4.97**	**5.06**	**4.33**	**2.82**
	(0.85)	(0.98)	(0.96)	(0.09)	**(0.00)**	**(0.00)**	**(0.00)**	**(0.02)**
F2	0.76	0.84	0.51	**2.45**	**3.03**	1.71	0.93	2.21
	(0.55)	(0.49)	(0.72)	**(0.04)**	**(0.01)**	(0.14)	(0.44)	(0.06)
F3	0.82	1.35	**2.71**	1.78	0.50	1.17	0.74	0.98
	(0.50)	(0.25)	**(0.03)**	(0.13)	(0.73)	(0.32)	(0.55)	(0.41)
F4	1.60	1.48	0.95	**3.22**	1.89	**3.25**	**3.23**	**5.26**
	(0.17)	(0.20)	(0.43)	**(0.01)**	(0.11)	**(0.01)**	**(0.01)**	**(0.00)**
F5	**195.16**	**448.07**	**604.66**	**715.85**	0.86	1.04	1.23	**3.46**
	(0.00)	**(0.00)**	**(0.00)**	**(0.00)**	(0.48)	(0.38)	(0.29)	**(0.00)**
F6	1.83	1.88	1.99	**3.91**	**4.18**	**3.71**	**6.27**	**4.92**
	(0.12)	(0.11)	(0.09)	**(0.00)**	**(0.00)**	**(0.00)**	**(0.00)**	**(0.00)**
F7	**2.74**	**3.84**	**2.31**	1.90	**24.91**	**18.43**	**23.38**	**31.99**
	(0.02)	**(0.00)**	**(0.05)**	(0.11)	**(0.00)**	**(0.00)**	**(0.00)**	**(0.00)**
F8	1.09	1.51	1.39	**2.34**	1.35	**2.45**	0.12	0.75
	(0.35)	(0.19)	(0.23)	**(0.05)**	(0.25)	**(0.04)**	(0.97)	(0.55)
F9	0.80	1.00	**2.47**	**2.59**	**3.01**	**2.86**	0.60	0.58
	(0.52)	(0.40)	**(0.04)**	**(0.03)**	**(0.01)**	**(0.02)**	(0.66)	(0.67)
F10	0.94	0.96	0.82	0.35	1.49	**2.29**	**3.09**	0.23
	(0.43)	(0.42)	(0.50)	(0.84)	(0.20)	**(0.05)**	**(0.01)**	(0.91)
		Germany				US		
R^2	0.49	0.67	0.84	0.91	0.79	0.90	0.96	0.97
Sum of coefficients on own lags	0.48	0.70	0.90	0.94	0.59	0.73	0.89	0.92
F1	0.94	1.45	1.34	0.32	0.93	1.56	1.79	0.17
	(0.44)	(0.21)	(0.25)	(0.86)	(0.44)	(0.18)	(0.13)	(0.95)
F2	**3.01**	**3.92**	**2.36**	**3.32**	**3.14**	**2.49**	1.87	0.57
	(0.01)	**(0.00)**	**(0.05)**	**(0.01)**	**(0.01)**	**(0.04)**	(0.11)	(0.67)
F3	**3.09**	**4.79**	1.30	1.58	**4.26**	**4.70**	**3.13**	0.69
	(0.01)	**(0.00)**	(0.26)	(0.18)	**(0.00)**	**(0.00)**	**(0.01)**	(0.59)
F4	0.93	**2.32**	2.16	1.42	0.69	0.99	0.28	1.97
	(0.44)	**(0.05)**	(0.07)	(0.22)	(0.59)	(0.41)	(0.88)	(0.09)
F5	1.98	**2.38**	2.29	**3.61**	1.87	1.66	**2.90**	0.56
	(0.09)	**(0.05)**	(0.06)	**(0.00)**	(0.11)	(0.15)	**(0.02)**	(0.68)
F6	**18.57**	**22.42**	**69.25**	**105.05**	0.80	0.42	2.26	0.68
	(0.00)	**(0.00)**	**(0.00)**	**(0.00)**	(0.52)	(0.79)	(0.06)	(0.60)
F7	0.92	**2.55**	2.16	0.96	0.81	1.22	1.38	1.63
	(0.45)	**(0.04)**	(0.07)	(0.42)	(0.51)	(0.29)	(0.23)	(0.16)
F8	1.29	0.91	0.23	0.17	**42.33**	**96.68**	**348.43**	**425.13**
	(0.27)	(0.45)	(0.92)	(0.95)	**(0.00)**	**(0.00)**	**(0.00)**	**(0.00)**
F9	**4.84**	**4.12**	**5.18**	**3.65**	1.29	**2.54**	0.91	1.62
	(0.00)	**(0.00)**	**(0.00)**	**(0.00)**	(0.27)	**(0.04)**	(0.45)	(0.16)
F10	0.50	0.64	0.60	1.03	**10.80**	**8.41**	**2.46**	**2.74**
	(0.73)	(0.62)	(0.66)	(0.38)	**(0.00)**	**(0.00)**	**(0.04)**	**(0.02)**

NOTES: F1 = an F-test that all lags on Italian inflation are zero; F2 = F-test for the lags on German inflation; F3 and F4 = F-tests for French and the US inflation lags; F5, F6, F7 and F8 = F-tests for the lags of changes in Italian, German, French and the US industrial production, correspondingly; and finally, F9 and F10 = F-tests for the Euro3 and US 1-month interest rate lags. Marginal significance levels are given in parenthesis. Test values indicating parameter values that are jointly significantly different from zero at least at 5% risk level have been highlighted with boldface.

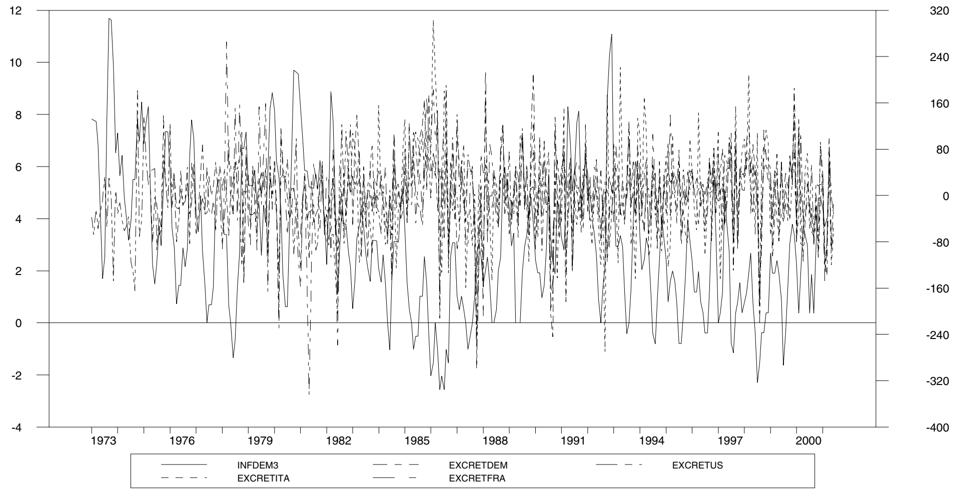
Figure A1. **Macro variables and excess returns (macro variables with continuous black lines, left scale, excess returns with different patterns, right scale).**

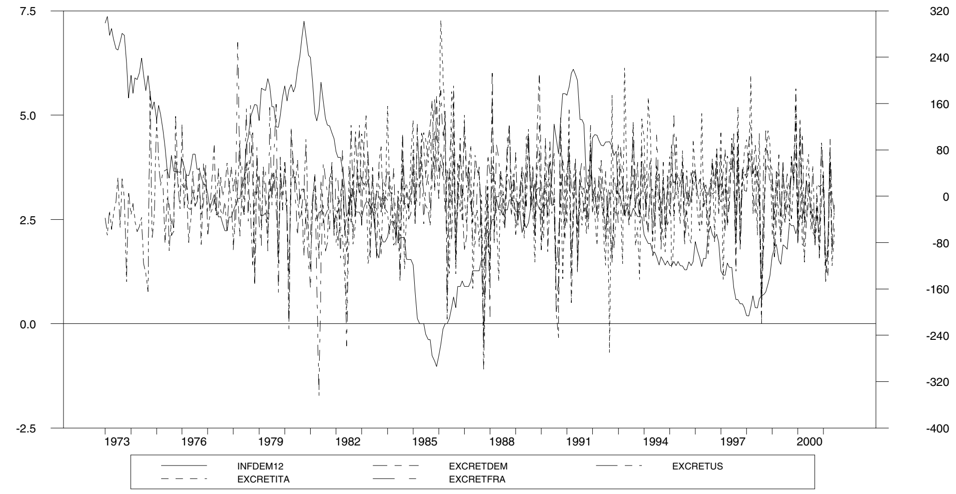
Germany



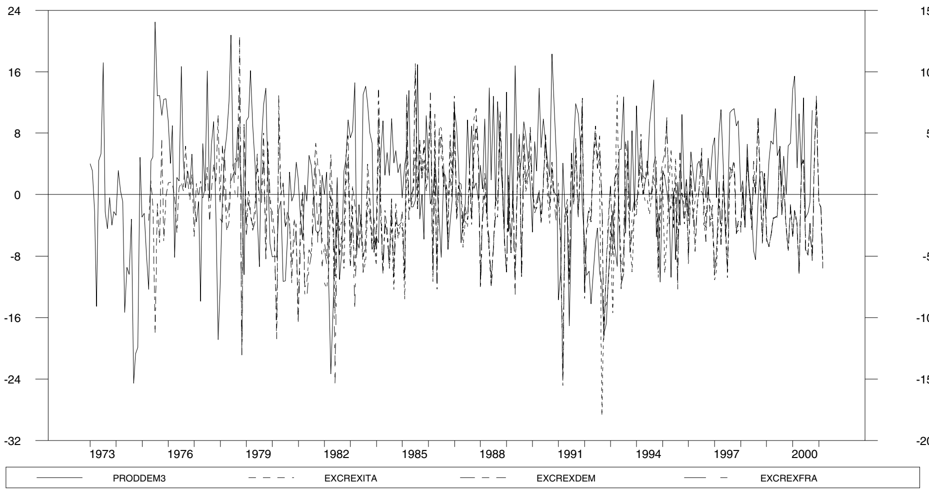


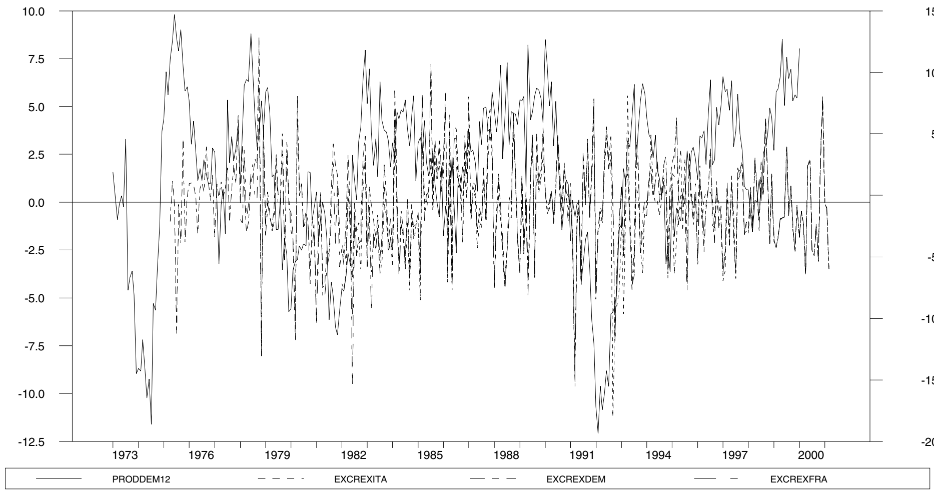
Future 3-month inflation (INFDEM3, upper panel) and 12-month inflation (INFDEM12, lower panel) vs. current excess returns on currency portfolios; EXREXITA, EXREXDEM and EXREXFRA refer to excess returns calculated on Italian lira, German mark and French franc portfolios, correspondingly (values of the currencies measured as the US dollar/Euro country currency unit)



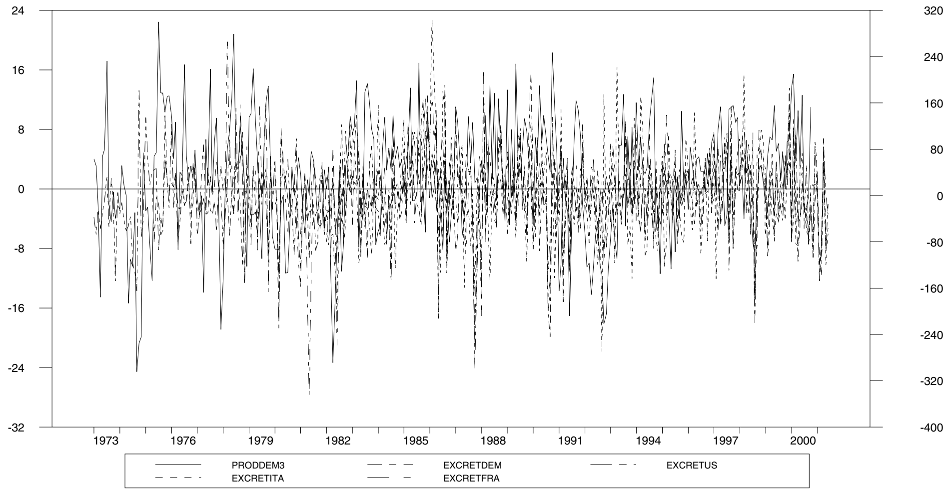


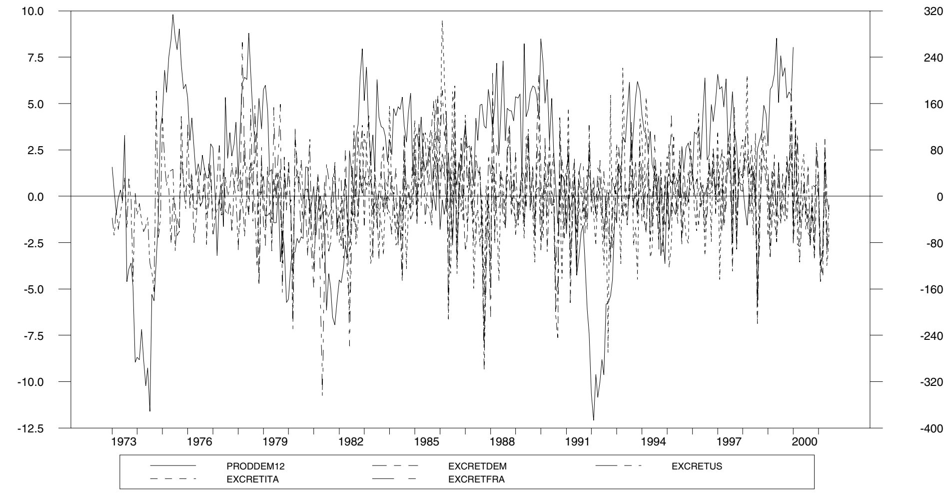
Future 3-month inflation and 12-month inflation vs. current excess stock returns. EXRETITA, EXRETDEM, EXRETFRA and EXRETUS refer to excess stock returns (annualised monthly %-returns) calculated on Italian, German, French and US stock portfolios, correspondingly.





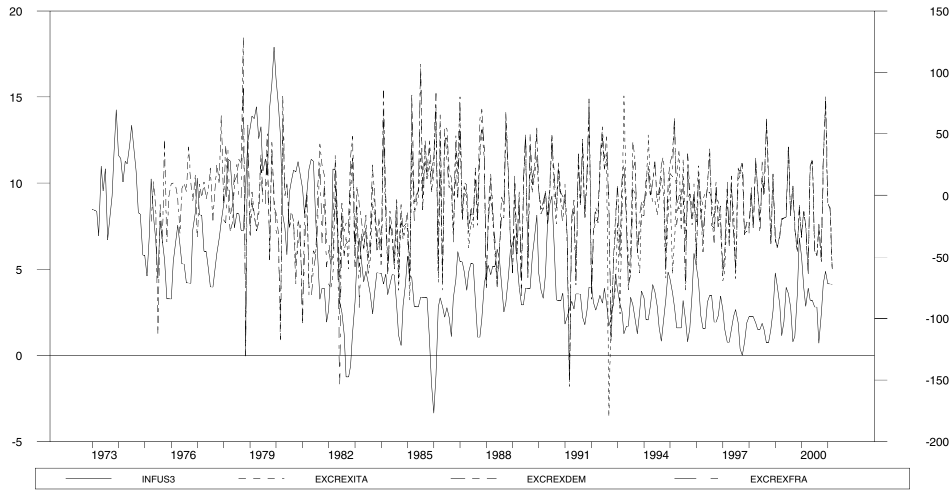
Future 3-month change (PRODDEM3, upper panel) and 12-month change (PRODDEM12, lower panel) in industrial production vs. current excess currency returns

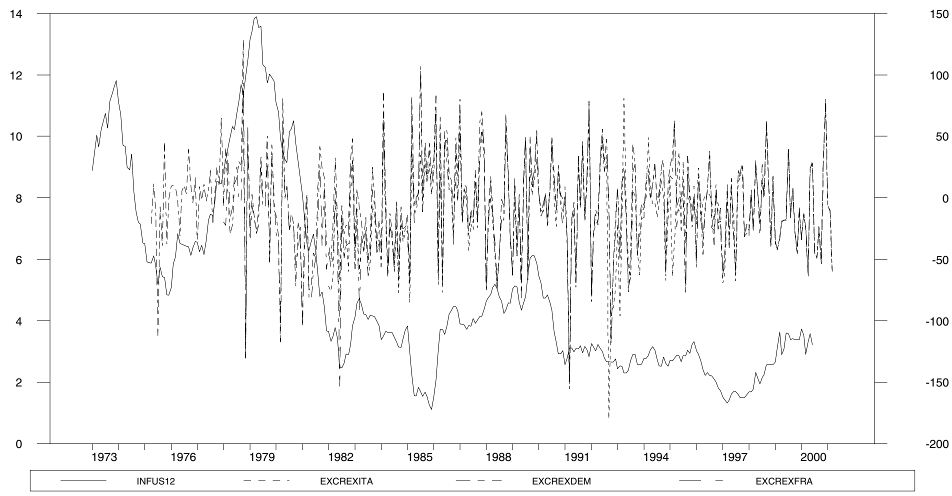




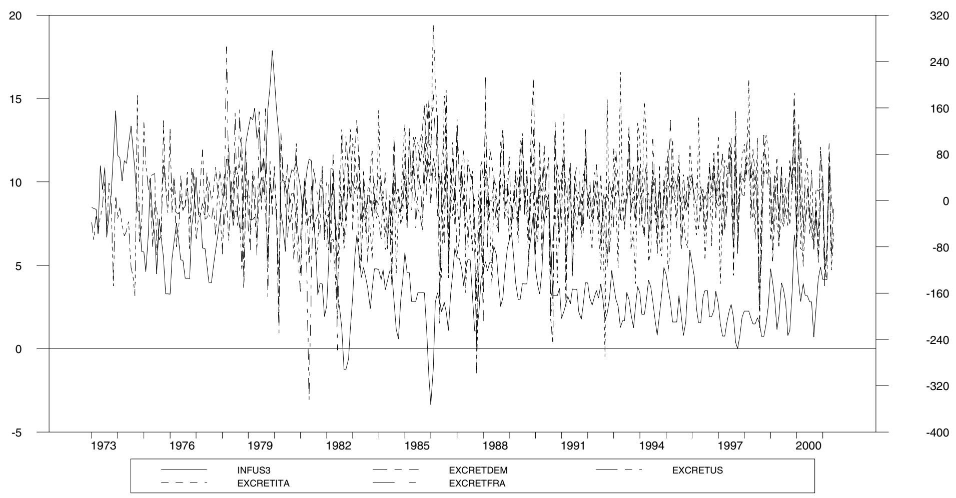
Future 3-month change (PRODDEM3, upper panel) and 12-month change (PRODDEM12, lower panel) in industrial production vs. current excess stock returns

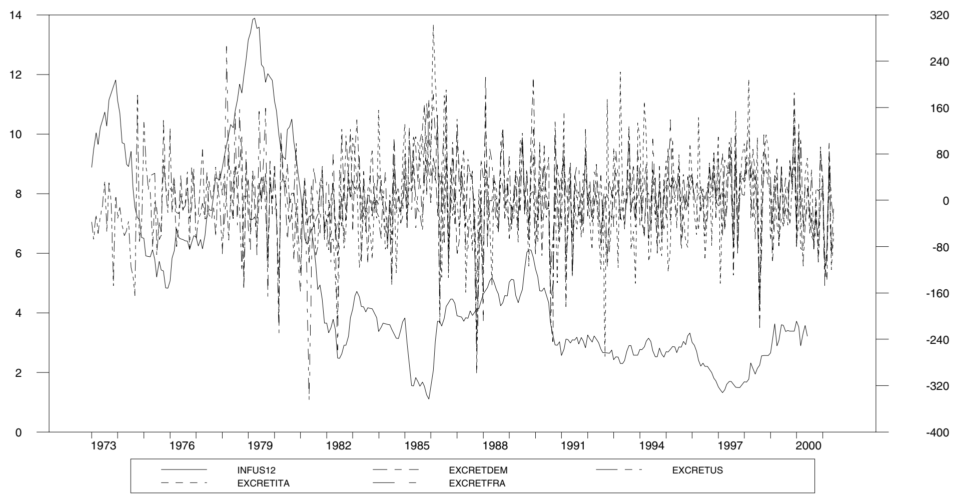
The US



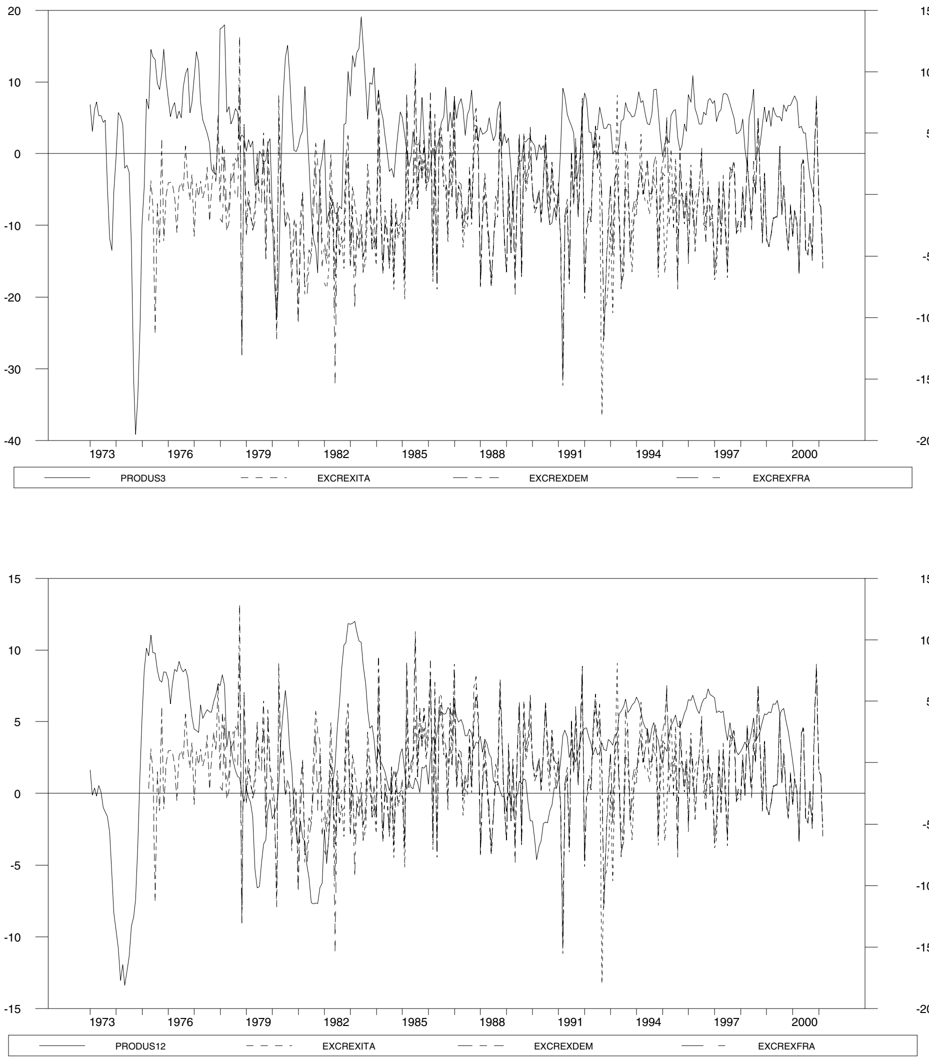


Future 3-month inflation (INFUS3, upper panel) and 12-month inflation (INFUS12, lower panel) vs. current excess returns on currency portfolios; EXREXITA, EXREXDEM and EXREXFRA refer to excess returns calculated on Italian lira, German mark and French franc portfolios, correspondingly (values of the currencies measured as the US dollar/Euro country currency unit)

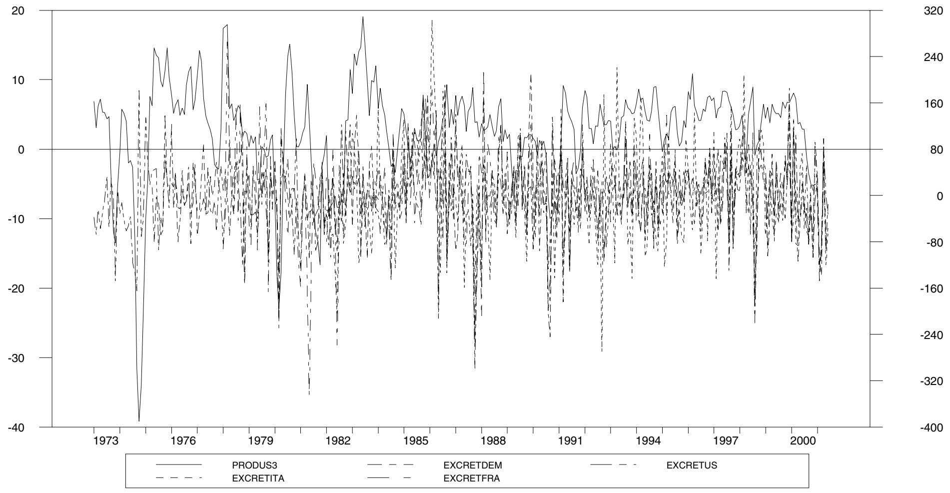


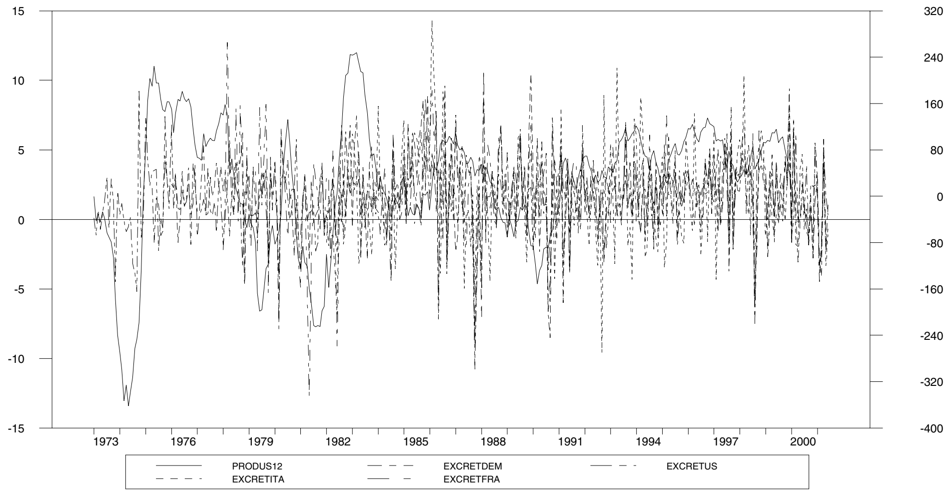


Future 3-month inflation and 12-month inflation vs. current excess stock returns. EXRETITA, EXRETDEM, EXRETFRA and EXRETUS refer to excess stock returns (annualised monthly %-returns) calculated on Italian, German, French and US stock portfolios, correspondingly.



Future 3-month change (PRODUS3, upper panel) and 12-month change (PRODUS12, lower panel) in industrial production vs. current excess currency returns





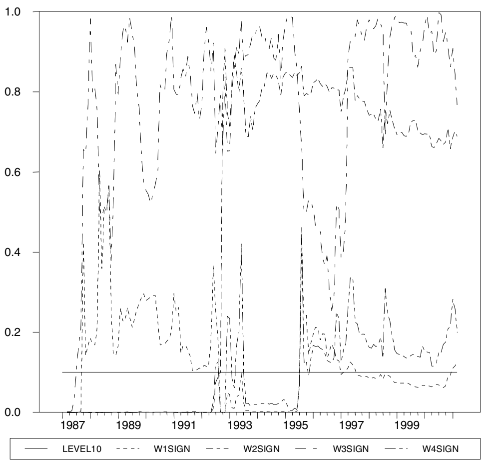
Future 3-month change (PRODUS3, upper panel) and 12-month change (PRODUS12, lower panel) in industrial production vs. current excess stock returns

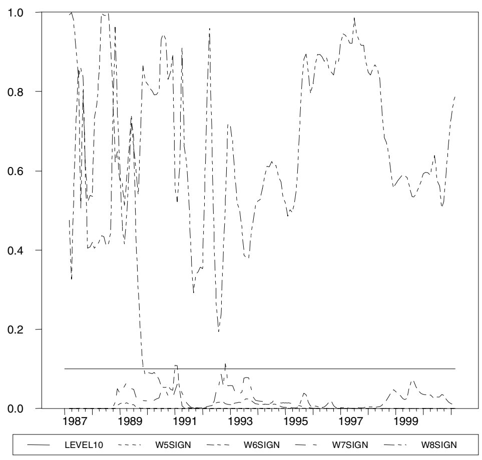
Figures A2. **Figures from recursive Wald-tests for testing the significance of tracking portfolio returns and control variables in the full ETP model. The null hypotheses for the eight different Wald-tests are**

W1 = coefficients on excess Euro currency returns are all zero
W2 = coefficients on all the Euro stock market excess returns are zero
W3 = the coefficient on the US stock market excess return is zero
W4 = coefficients on all the 7 asset excess returns are zero
W5 = coefficients on Euro market dividend yields are all zero
W6 = the coefficient on the US market dividend yield is zero
W7 = coefficients on the Euro market term spreads are all zero
W8 = the coefficient on the US market term spread is zero.
When the line describing the significance of the specific test statistic (W#SIGN) goes below the 10% line (LEVEL10), the coefficient(s) on the analysed variable(s) are significantly different from zero at 10% risk level. The left hand figure is always for the significance of ETP-returns and the right hand figure for the significance of controls

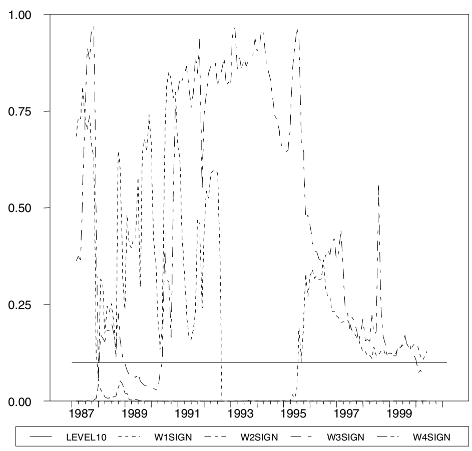
Future inflation in Germany

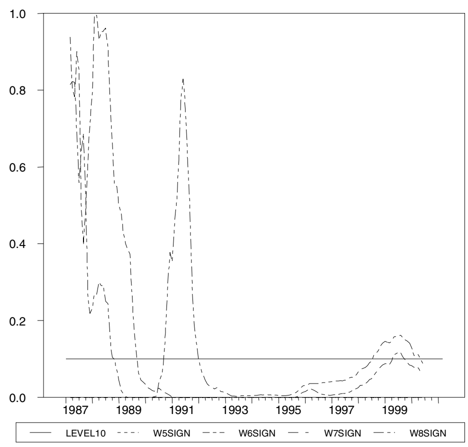
3-month horizon



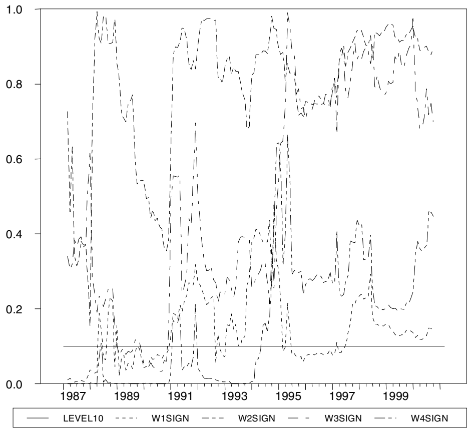


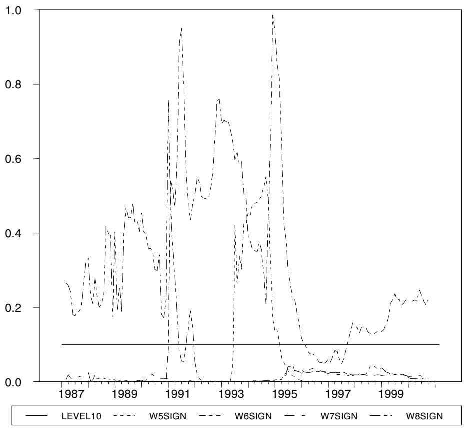
12-month horizon



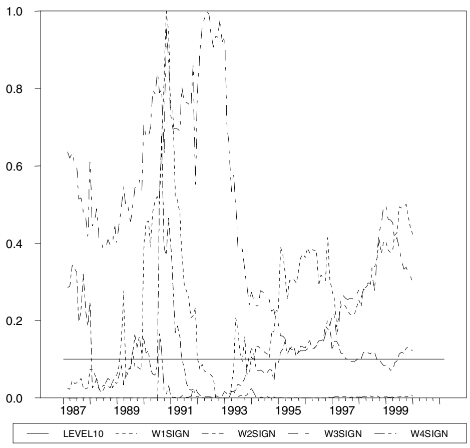


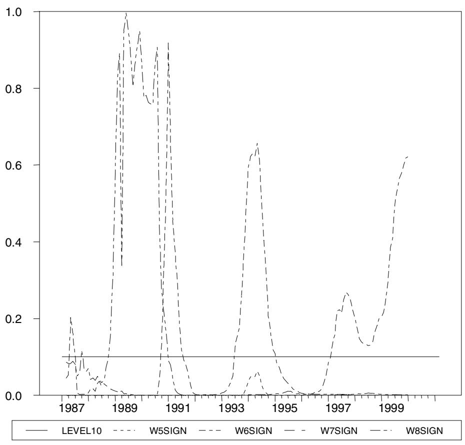
Change in future industrial production in Germany; 3-month horizon



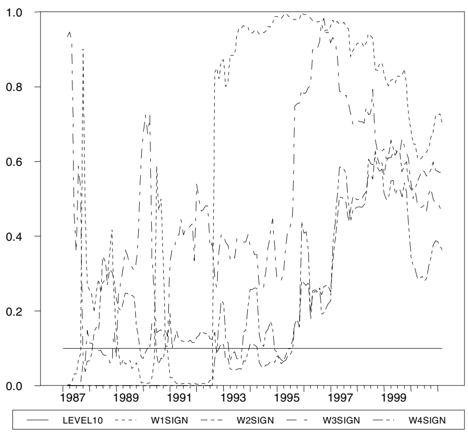


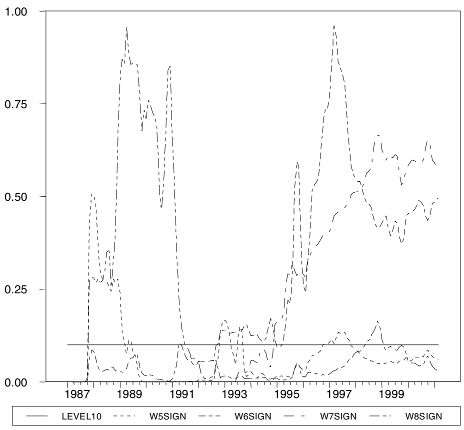
12-month horizon



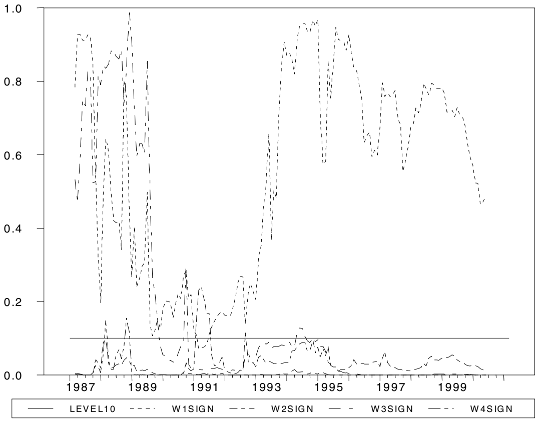


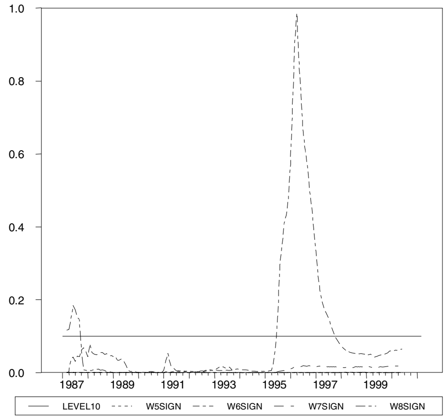
Future inflation in the US; 3-month horizon



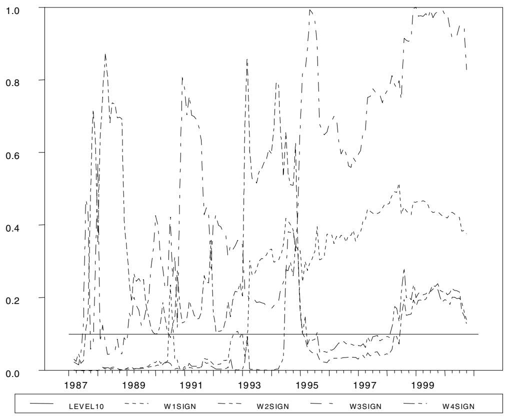


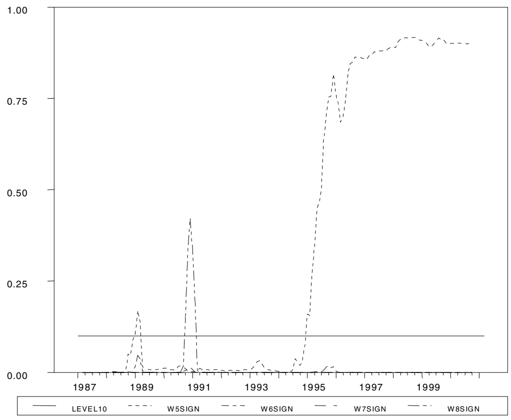
12-month horizon



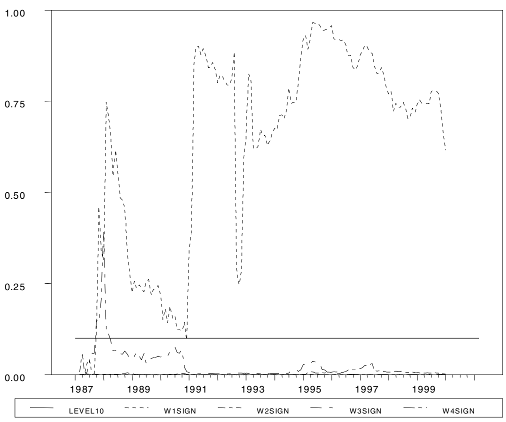


Changes in future industrial production in the US; 3-month horizon





12-month horizon



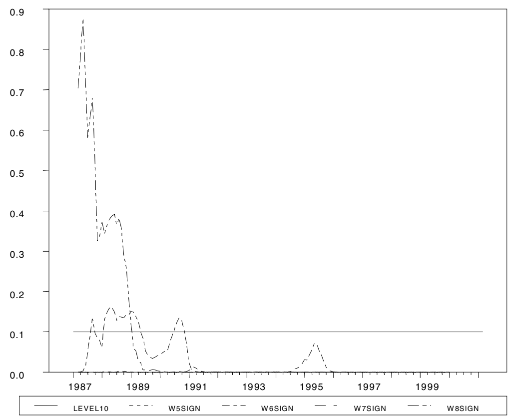
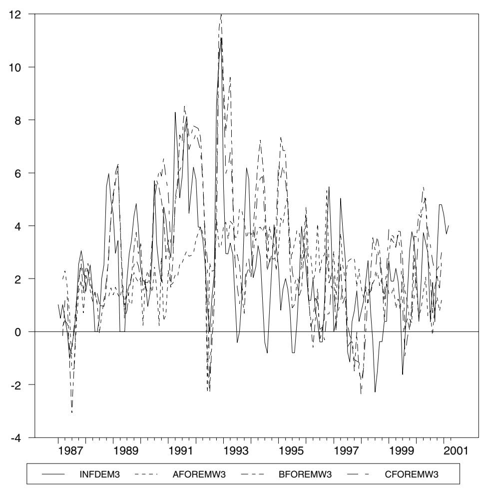


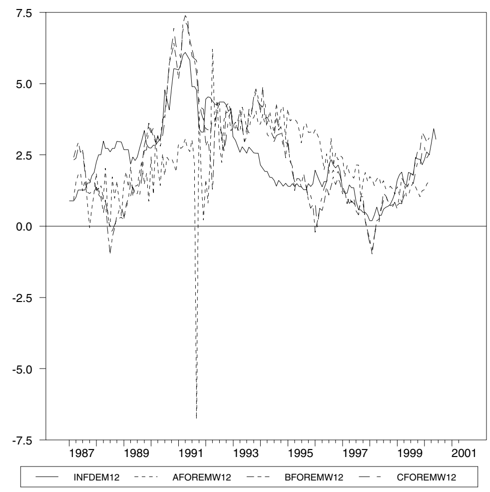
Figure A3. **Out-of-sample forecasts and actual values for future inflation and changes in industrial production. Forecasts are obtained from a rolling estimation procedure with a 5-year moving window. Cases a, b, and c refer to the ETP-models where only the excess returns (AFOREMW#), both excess returns and controls (dividend yields and term spreads from each of the analysed countries) (BFOREMW#), or only the controls (CFOREMW#) have been used in the estimation.**

Germany
Future inflation

3-month horizon

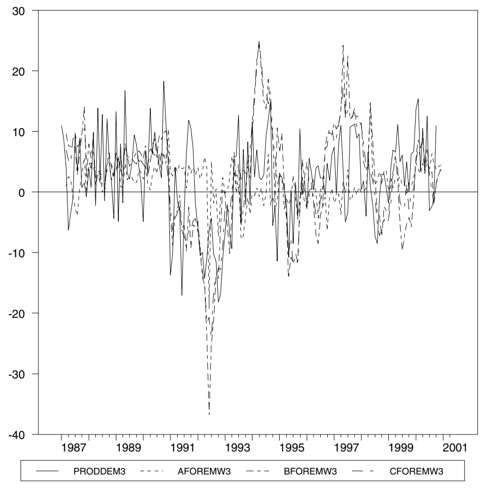


12-month horizon

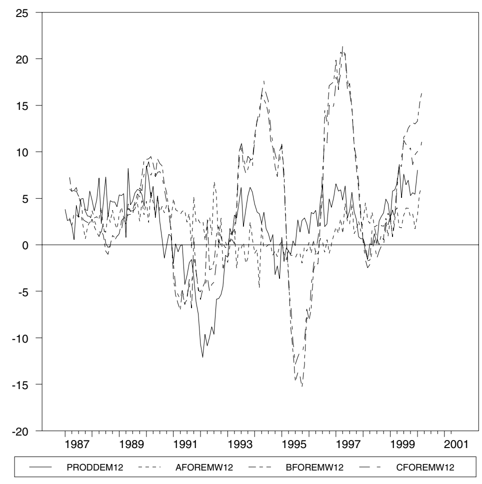


Changes in future industrial production

3-month horizon

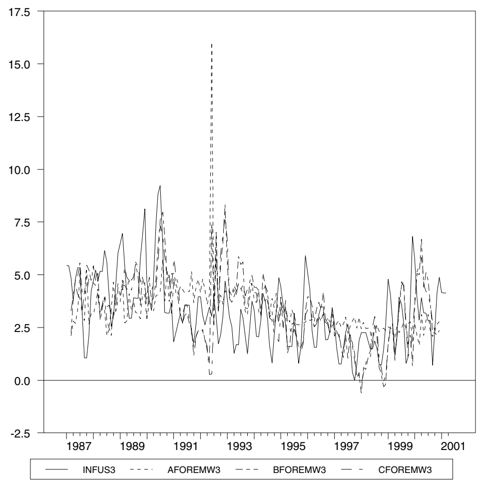


12-month horizon

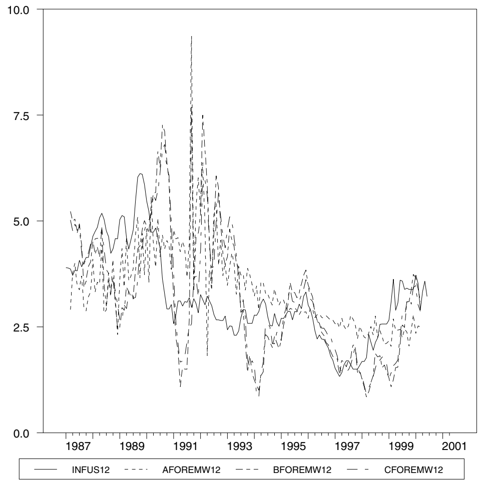


The US
Future inflation

3-month horizon

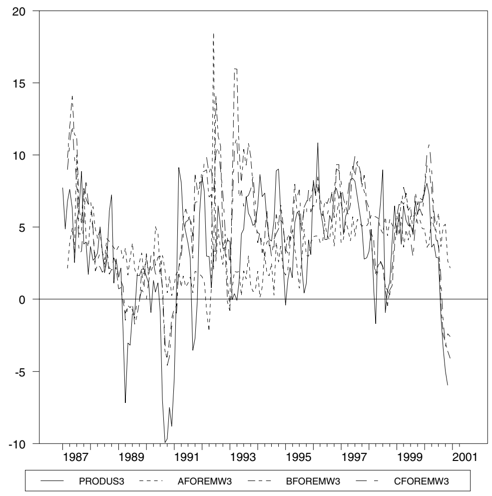


12-month horizon



Changes in future industrial production

3-month horizon



12-month horizon

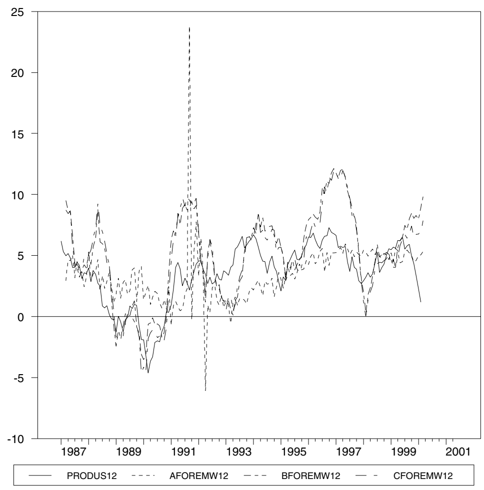
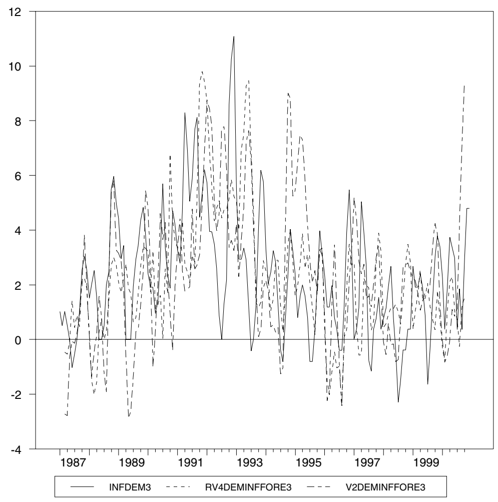


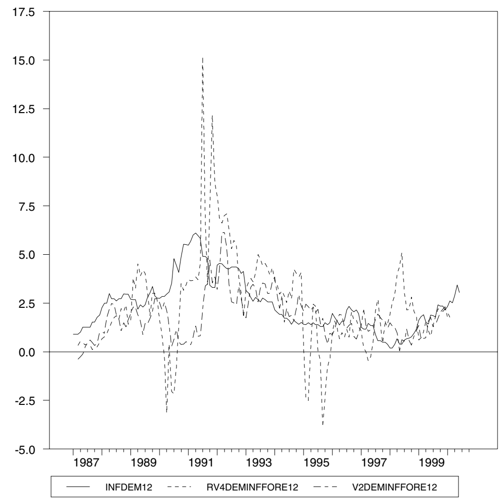
Figure A4. **Out-of-sample forecasts and actual values for future inflation and changes in industrial production from the two best performing benchmark VAR models (restricted VAR(4) and an unrestricted VAR(2)). Forecasts are again obtained from a rolling estimation procedure with a 5-year moving window.**

Germany
Future inflation

3-month horizon

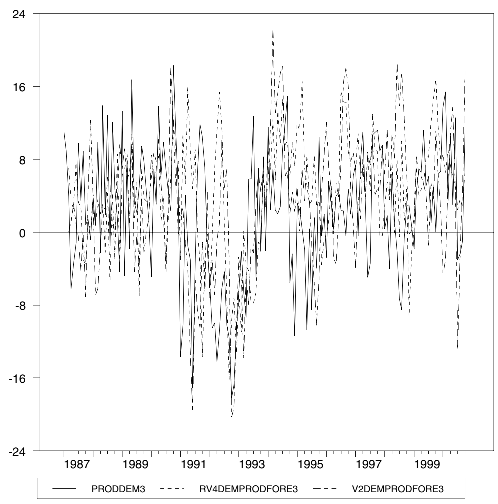


12-month horizon

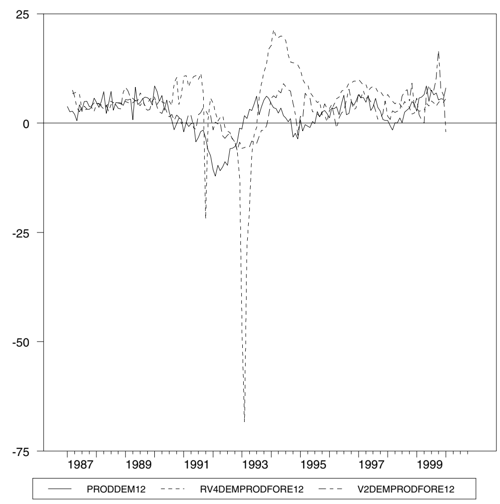


Changes in future industrial production

3-month horizon



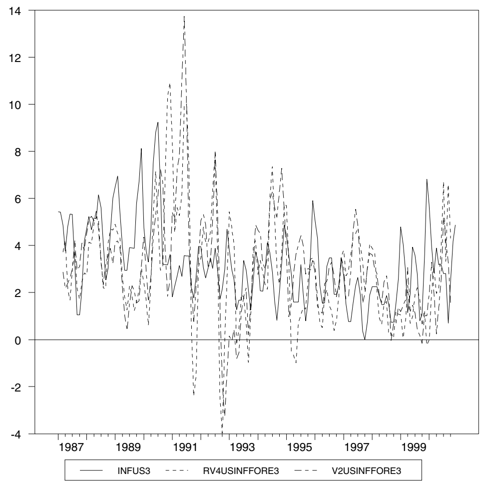
12-month horizon



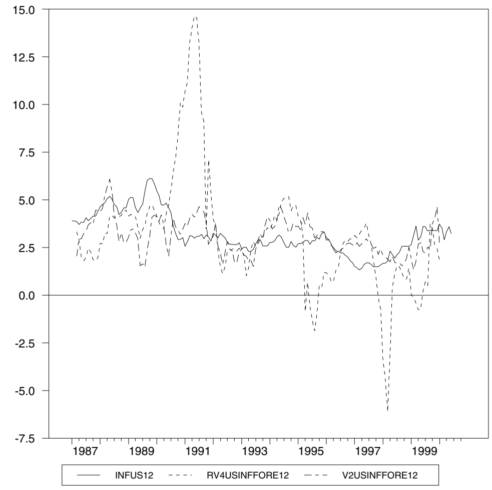
The US

Future inflation

3-month horizon

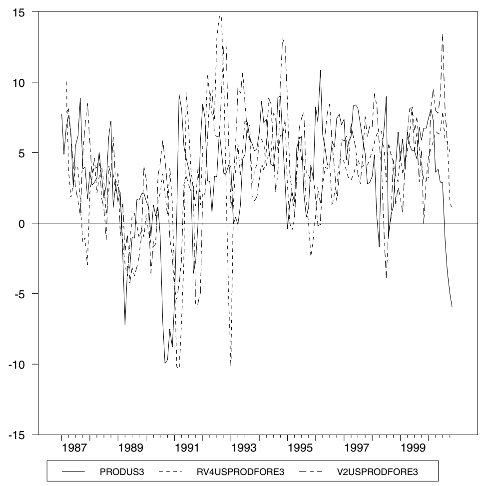


12-month horizon

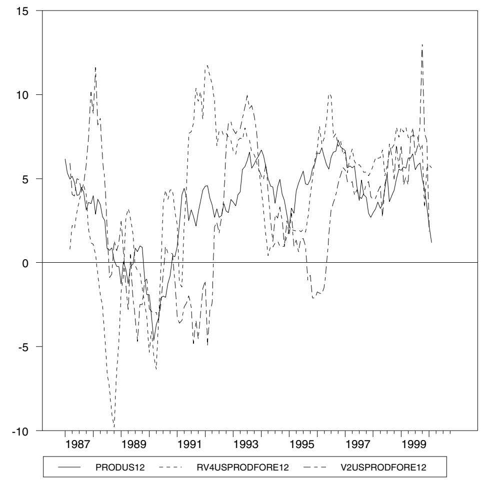


Changes in future industrial production

3-month horizon



12-month horizon



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